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PREPRINT

SATELLITE DATA RECOVERY AND QUALITY FOR LOW ELEVATION TRACKING ANGLES

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MAY 1969

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GREENBELT, MARYLAND

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ABSTRACT

A PCM telemetry performance monitor has been developed by the Information Processing Division which provides a data recovery and data quality analyses of a recorded satellite pass along with a strip chart presentation of pertinent characteristics of tape recorded signals. This monitor enables one to perform quantitative and qualitive analyses of a PCM telemetry signal. The evaluator was first used to examine the degradation of telemetry data due to low elevation tracking angles for the OGO-D and OSO-F satellites from several STADAN stations. These results were correlated with the world maps predictions, telemetry schedules, and the antenna profiles. Bit error rates are more than 10^{-2} at low elevation angles and become less than 10^{-5} as the elevation angle increases. Generally, data acquired near the horizon is either lost or severly degraded.

SATELLITE DATA RECOVERY AND QUALITY FOR LOW ELEVATION TRACKING ANGLES

I. INTRODUCTION

Tracking data is used to predict a satellite's orbit; world maps predictions ("Predicts") and telemetry schedules are then generated and sent to the STADAN for use in satellite tracking and telemetry data recording. The world map predictions, generated by the Computations Division, contain such information as satellite range, and antenna elevation and azimuth tracking angles as a function of time. The stations track a satellite using the Project Operations Support Division confirmed telemetry schedule and record the telemetry data on analog tapes. The analog tapes are sent to the Information Processing Division (IPD) for analog-to-digital conversion and computer processing to obtain the experimenters data tapes.

This report correlates the IPD's PCM telemetry data recovery and data quality results with the station antenna profiles for low elevation tracking angles.

II. INFORMATION PROCESSING EVALUATOR

The Information Processing Telemetry Systems performance was obtained using the IPD's E-5 tape evaluation line with the addition of a PCM Performance Monitor, recently developed by the Processor Development Branch, which provides strip chart and quality analyses of various recorded analog signals. The strip chart contains information such as: (1) the receiver AGC sensitivities, (2) the PCM tape evaluation processor search-to-lock indicator (indication of IPD's data recovery), (3) an average frame sync error rate indicator (indication of IPD's data quality), (4) the bit synchronizer 1/2 bit slippage indicator (indication of jitter), (5) STADAN and IPD's combined ground tape recorder reproduce wow/flutter and drift characteristics, (6) the serial decimal time code, and (7) an indication of the signal plus noise (S + N) amplitude level variations of the "raw" PCM signal, (See figure 1).

The performance monitor also counts the percentage of frame sync words recovered with zero bit errors when the PCM system is in "lock" mode. This parameter, labeled FOE, is used to estimate bit error probability when the process is stationary and the bit errors are independent. The denominator of FOE is the number of frames recovered and is an indication of data recovery.

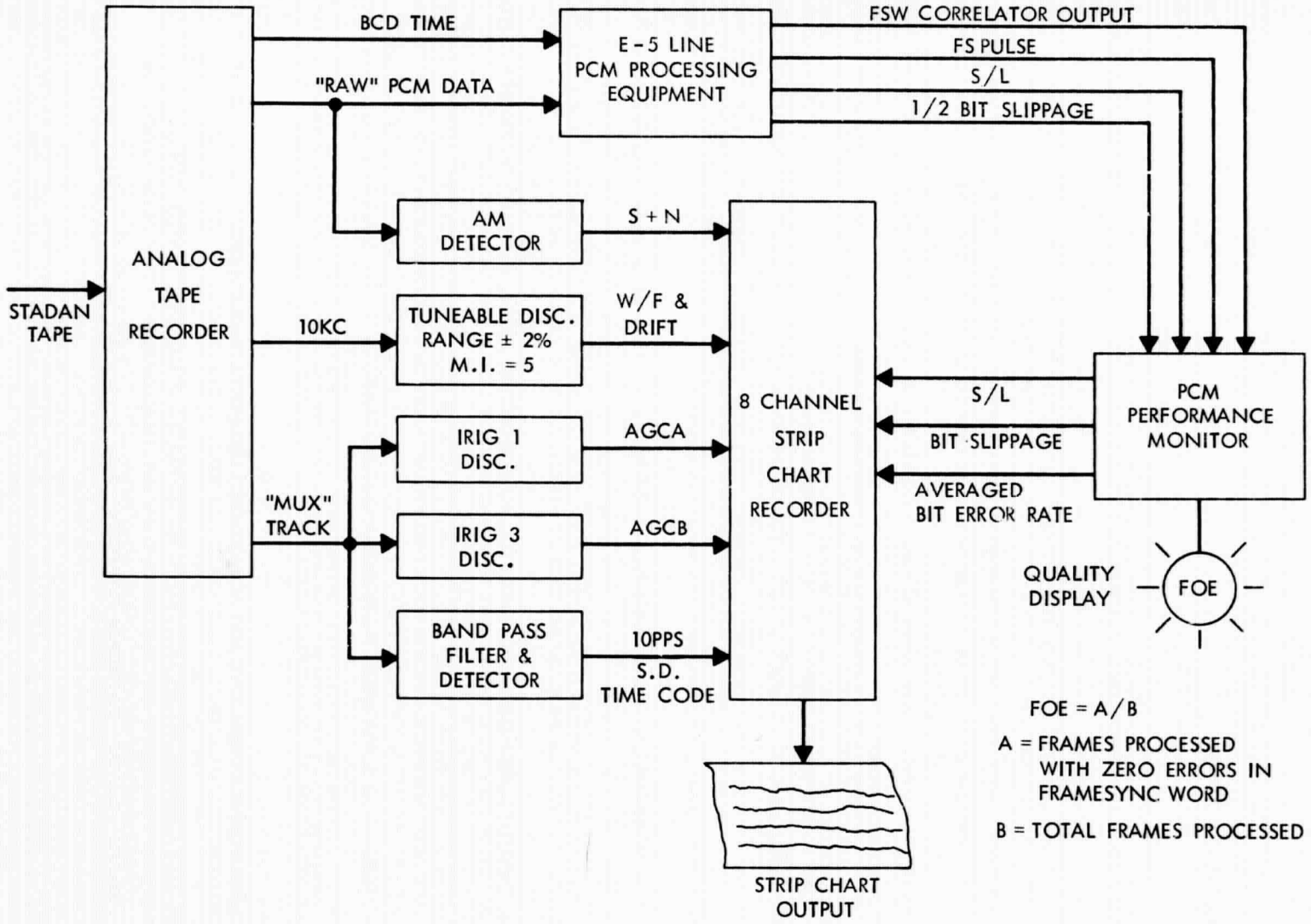


Figure 1–The IPD PCM Tape Evaluation System.

III. CORRELATION OF ORBIT PREDICTIONS, TELEMETRY SCHEDULES, AND IPD EVALUATION RESULTS

OGO-D

Nineteen OGO-D (64 KC Real Time) passes, recorded March 11, 1969 to March 17, 1969 from Santiago, Quito, Ororal, and Rosman STADAN stations were selected at random and evaluated using the equipment described in Section II. A strip chart for each analog tape (pass) was obtained. Figure 2 contains a strip chart of an OGO-D tape examined from Santiago. Plotted on the top chart are the elevation and azimuth angles taken from the "predicts." The combined time errors for predictions and plots are less than 10 seconds for the OGO-D passes analysed in this report.

Immediately below, the azimuth and elevation plot contains the receiver AGC sensitivities (channels A and B). Also shown is the PCM processor search-to-lock indicator, the average frame sync error rate from a frame sync analog correlator (sampled and held) and the bit synchronizer 1/2 bit slippage indicator. The ground tape recorder reproduce performance is also indicated on the strip chart. The S + N variation of the "raw" PCM data was not available during the OGO-D strip chart analyses.

The error rate at the beginning of the Santiago pass (elevation angles between 4° and 9.5°) is approximately 10^{-2}, whereas the overall estimated average error rate for the pass is 2.4×10^{-5}. This high overall error rate is due primarily to the burst type errors occurring at the low elevation angles.

Appendix A contains the strip charts of the other eighteen OGO-D tapes examined in this report.

Table I shows a comparison of the scheduled, STADAN reported, and the IPD actual results for these nineteen OGO-D passes. The stations command "on" the 64 KC real time data when a sufficient received power level from one of the transmitting R.F. carriers is detected. From Table I, the STADAN AOS/LOS* times were within one to two minutes of the "predicts." Note that IPD's data recovery (minutes of recovered data) agrees closely with the STADAN reported approximate minutes of data. However, eight out of the ninteen tapes or 42% of the passes examined contained severly degraded data (Probability of error $> 10^{-4}$) at low elevation angles.

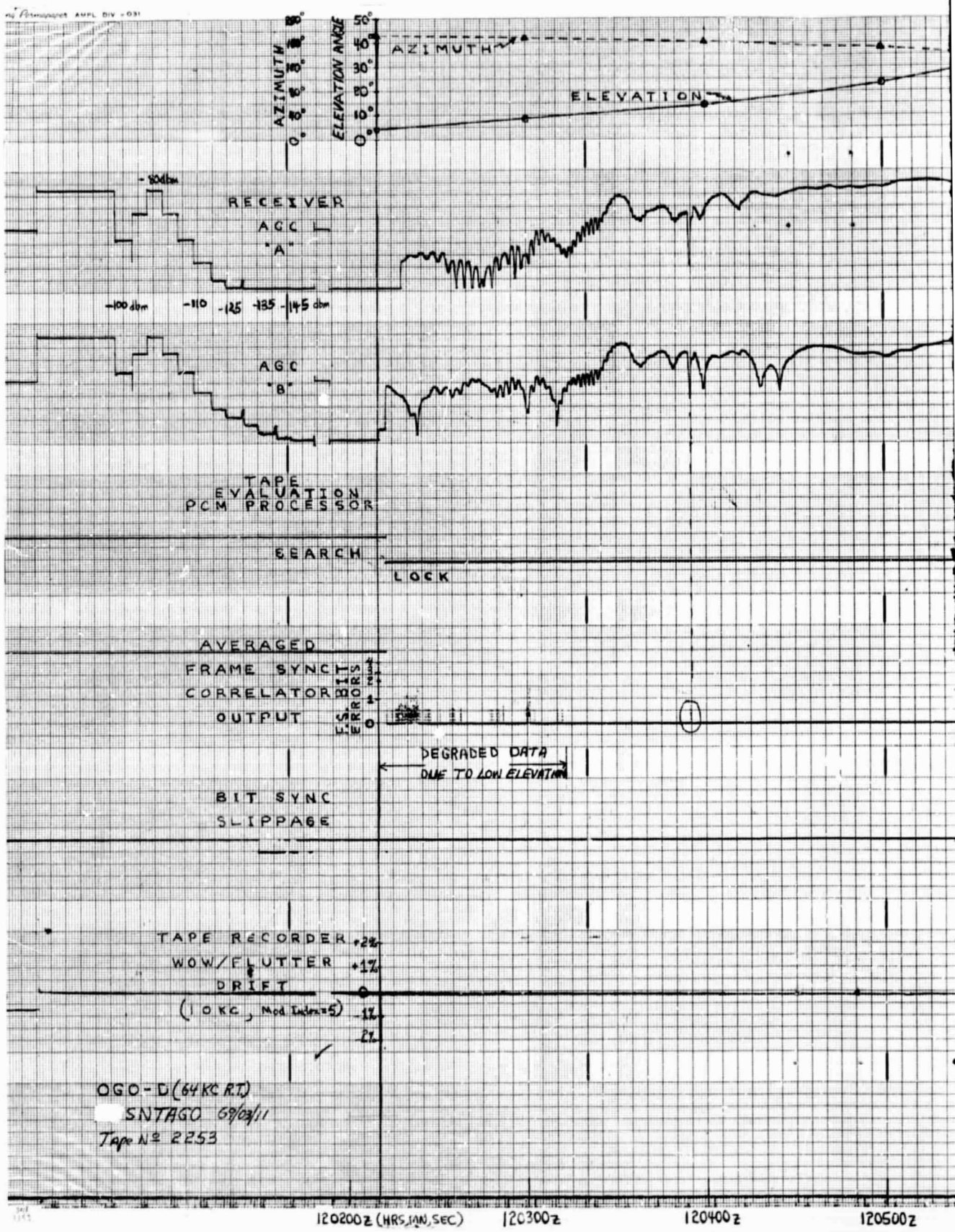
*Acquisition-of-signal/loss-of-signal.

TABLE I

Comparison of Scheduled, STADAN Reported, and the IPD Actual Results for OGO-D (64 KC R.T.) Data

STADAN Station	Date Recorded	Anglog Tape Number	Telemetry Schedule				STADAN Reported Acquisition					IPD Actual			
			Pass Start	Recorder On	Recorder Off	Pass Duration (minutes)	Recorder On*	Recorder Off*	AOS	LOS	Minutes of Data	AOS	LOS	Data Recovered (minutes)	Ave. P_e
SNTAGO	690311	2253	1201	1201	1213	12.0	1202	1211	120210	121046	8.5	120213	121046	8.5	2.4×10^{-5}
	690312	2255	0026	0026	0037	11.0	0028	0036	002856	003613	7.3	002905	003613	7.1	1.7×10^{-3}
	690312	2257	1213	1213	1226	13.0	1214	1225	121427	122520	11.0	121431	122524	10.8	7.4×10^{-4}
	690313	2259	0039	0039	0050	11.0	0040	0048	004055	004845	7.8	004056	004849	7.8	4.7×10^{-4}
	690313	2261	1226	1226	1239	13.0	1227	1238	122749	123820	10.0	122803	123818	10.2	2.4×10^{-4}
	690314	2263	0052	0052	0103	11.0	0053	0103	005405	010057	6.9	005401	010055	6.8	2.4×10^{-3}
QUITOE	690315	924	0056	0056	0107	11.0	0056	0107	005718	010655	9.7	005718	010653	9.6	3.4×10^{-5}
	690316	927	0109	0109	0119	10.0	0109	0120	011002	011918	9.2	011006	011919	9.2	4.8×10^{-5}
	690317	934	1326	1326	1338	12.0	1327	1338	132802	133715	9.2	132804	133716	9.1	1.8×10^{-3}
ORORAL	690313	2956	2030	2030	2041	11.0	2028	2041	203208	203925	7.2	203211	203928	7.3	2.4×10^{-5}
	690314	2959	2042	2042	2055	13.0	2041	2054	204458	205332	8.6	204455	205330	8.5	5.0×10^{-5}
	690314	2961	2220	2220	2231	11.0	2217	2233	222422	222927	5.1	222423	222929	5.0	1.3×10^{-4}
	690315	2964	2050	2055	2108	13.0	2053	2018	205736	210643	9.1	205737	210644	9.1	3.0×10^{-4}
	690316	2966	0922	0922	0933	11.0	0921	0932	092447	093032	5.8	092445	093030	5.7	2.5×10^{-5}
ROSMAN	690311	3563	0132	0132	0144	12.0	0134	0142	013424	014201	7.3	013429	014204	7.6	2.0×10^{-5}
	690311	3566	1220	1220	1232	12.0	1220	1232	122024	123025	10.0	122027	123027	9.9	5.0×10^{-5}
	690312	3572	1232	1232	1245	13.0	1232	1246	123251	124356	11.0	123257	124400	11.0	1.5×10^{-5}
	690313	3578	1244	1244	1258	14.0	1245	1258	124519	125729	12.0	124520	125729	12.1	1.4×10^{-5}
	690315	3583	0047	0047	0056	9.0	0047	0056	004826	005600	8.0	004825	005558	7.5	2.0×10^{-5}

*Not including Pre- or Post-Pass Calibration Time Intervals



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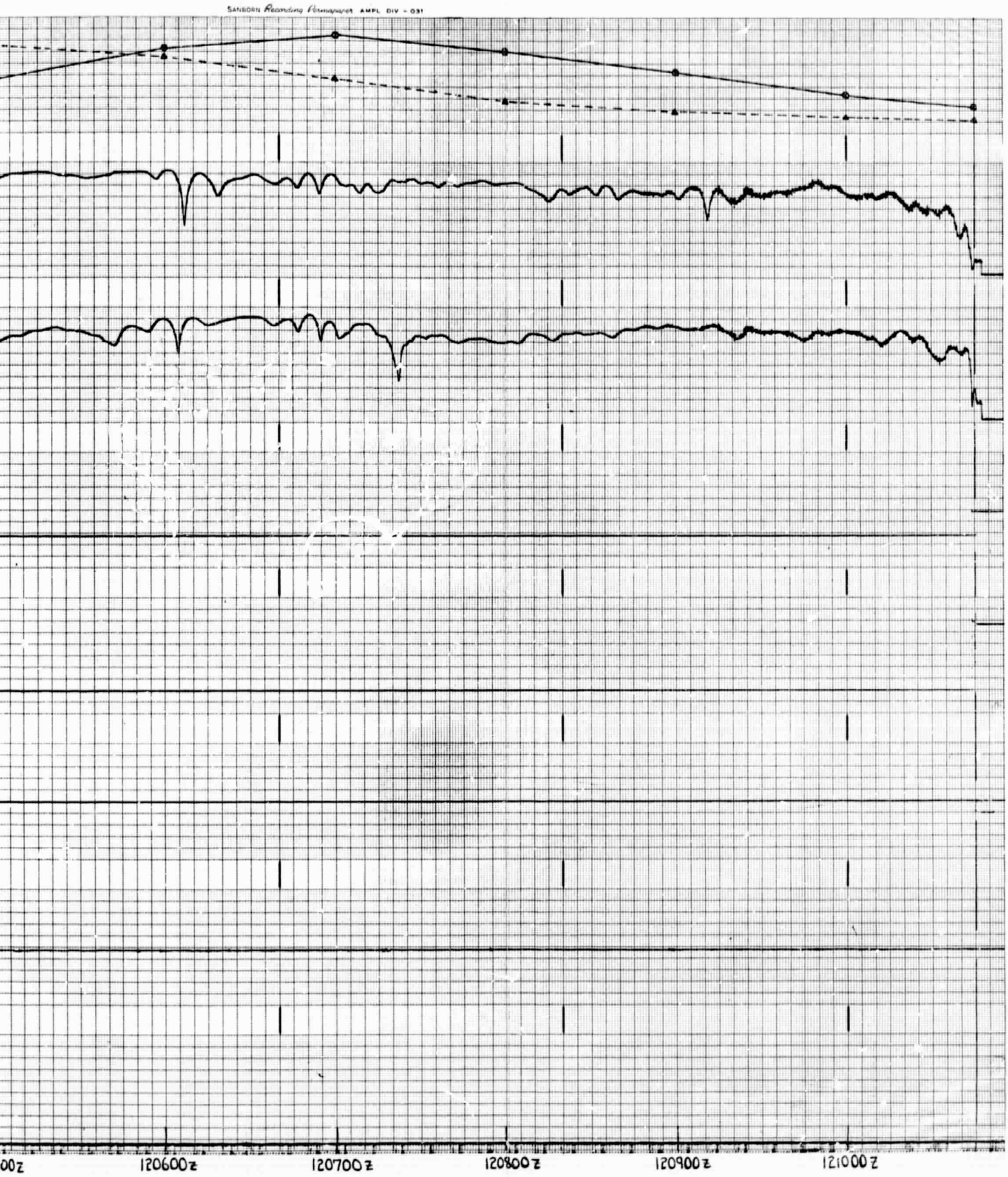

Figure 2—IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data; SNTAGO, Tape No. 2253

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OGO-F

Seventeen OSO-F (real-time data time multiplexed with playback data) passes, recorded January 26 to February 1, 1969 from Ororal, Santiago, Mojave, Fort Myers, Quito, and Lima were selected and evaluated because of the STADAN reported S/C RFI and atmospheric disturbances. The effect of loss of data and degraded data at low evaluation angles is more noticeable for OSO-F than for OGO-D primarily due to the different acquisition procedures for each satellite, e.g. OSO-F pass start begins at 0° elevation. The strip charts for seven of the seventeen tapes are shown in Appendix B. The seven strip charts contained in Appendix B were reported by STADAN as having either ionospheric or propagation disturbances (occurring around 03 hours 30 min 00 sec GMT which has been known to be a difficult time-of-day for reception of data for the South American Stations.) The other ten strip charts not shown are being used in another report, soon to be published, for an OSO-F spacecraft RFI study. The combined time errors for predictions and plots are less than 10 seconds for the OSO-F passes analyzed in this report.

Table II shows a comparison of the scheduled, STADAN reported, and the IPD actual results for all of the OSO-F tapes examined. The stations are requested to commence tracking the spacecraft and recording the OSO-F data near the horizon (0° elevation) with the purpose of obtaining as much data as possible for the project. The stations consistently tracked the spacecraft from horizon-to-horizon. The playback data was always scheduled over 10° elevation as a project requirement. The actual IPD AOS/LOS of the pass was within approximately 1/2 minute of the STADAN reported AOS and LOS respectively. One minute out of each eleven minute pass is either lost or severly degraded at the low elevation tracking angles. Fifteen out of the seventeen (88%) of the passes examined contained severely degraded data at low elevation angles. The average error rates are not shown in Table II due to the difficulty in separating the low elevation errors, ionospheric disturbances, and spacecraft RFI. However, the overall average error rates for the seventeen passes range from 10^{-1} to 10^{-3}

IV. CORRELATION OF THE IPD RESULTS AND THE ANTENNA PROFILES

The antenna profiles were obtained for each STADAN antenna used for the OGO-D and OSO-F passes analyzed in this report. The lost and degraded data intervals, for low elevation tracking angles, on the strip charts were correlated with the azimuth and elevation angles and then plotted on the antenna profiles. Figures 3 through 7 contain all of the OGO-D data tapes analyzed; figures 8 through 14 contain all of the OSO-F data tapes analyzed (including those which contained spacecraft RFI and are not shown in Appendix B).

TABLE II

Comparison of Scheduled, STADAN Reported, and the IPD Actual Results for OSO-F (RT & PB Data)

STADAN Station	Analog Tape Number	Date Recorded	Scheduled Telemetry				STADAN Reported				IPD Actual				
			Pass Start	PB Time Start	Pass Stop	Minutes of RT&PB Data	AOS	LOS	Minutes of Pass	Minutes of PB Data	AOS	LOS	Minutes of RT Data	Minutes of PB Data	Total Minutes of Data
MOJAVE**	7	690126	1613	–	1626	13.0	101349	162652	13.0	2.0*	161354	162618	11.1	1.0	12.1
SNTAGO**	17	690127	0059	0102	0112	13.0	005955	011105	11.0	5.6	010002	011043	3.8	5.6	9.4
	18	690127	0240	0244	0252	12.0	024045	025202	11.0	5.6	024127	025140	4.3	4.5	8.8
	28	690129	2300	2304	2313	13.0	230158	231250	11.0	5.6	230255	231207	3.5	5.5	9.0
	39	690201	2102	2105	2115	13.0	210251	211400	11.0	5.6	210253	211339	4.2	4.8	9.0
ORORAL**	26	690128	1028	–	1040	12.0	102840	104008	11.0	–	102942	104000	10.0	–	10.0
	27	690128	1209	–	1220	11.0	121055	121830	7.6	–	121112	121725	5.9	–	5.9
	40	690131	1011	–	1022	11.0	101240	102048	7.8	–	101239	101905	6.5	–	6.5
FTMYRS**	32	690128	1248	1251	1301	13.0	124825	130138	11.6	4.0	124825	130136	7.5	3.8	11.3
	45	690131	1049	1053	1102	13.0	104946	110250	13.1	5.6	104947	110228	6.4	5.4	11.8
QUITOE	9	690201	0355	0358	0408	13.0	035542	040800	12.3	5.7	035555	040711	5.6	5.2	10.8
LIMA	8	690127	0422	0426	0435	13.0	042220	043455	12.0	5.6	042242	043431	6.1	5.5	11.6
	9	690127	0604	0608	0616	12.0	060355	061540	12.0	5.6	060417	061532	5.5	5.4	10.9
	13	690129	0411	0414	0423	12.0	041102	042313	12.0	5.6	041111	042303	6.1	5.5	11.6
	14	690130	0405	0409	0418	13.0	040510	041730	12.0	5.6	040513	041707	6.1	5.5	11.6
SNTAGO	14	690126	0246	0250	0258	12.0	024657	025750	11.0	5.6	024657	025740	5.1	4.2	9.3
	22	690128	0235	0238	0246	11.0	023512	024613	11.0	5.6	023530	024609	4.5	4.7	9.2

*Not Scheduled

**These PASSES contain spacecraft RFI

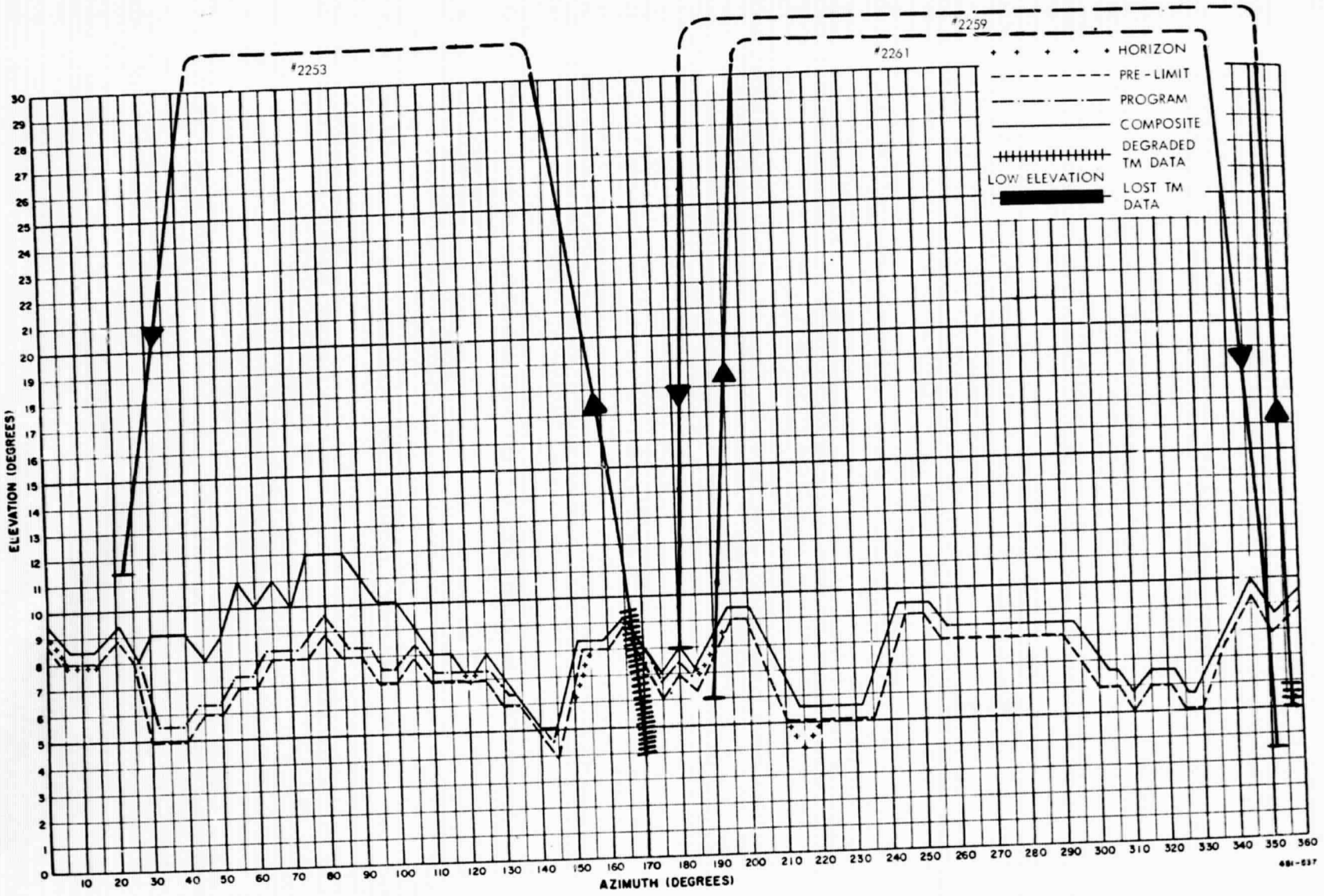

Figure 3–40-foot Dish Linear Mask (OGO-D, 64 KC R.T., Tape Nos. 2253, 2259, 2261 – SNTAGO Station).

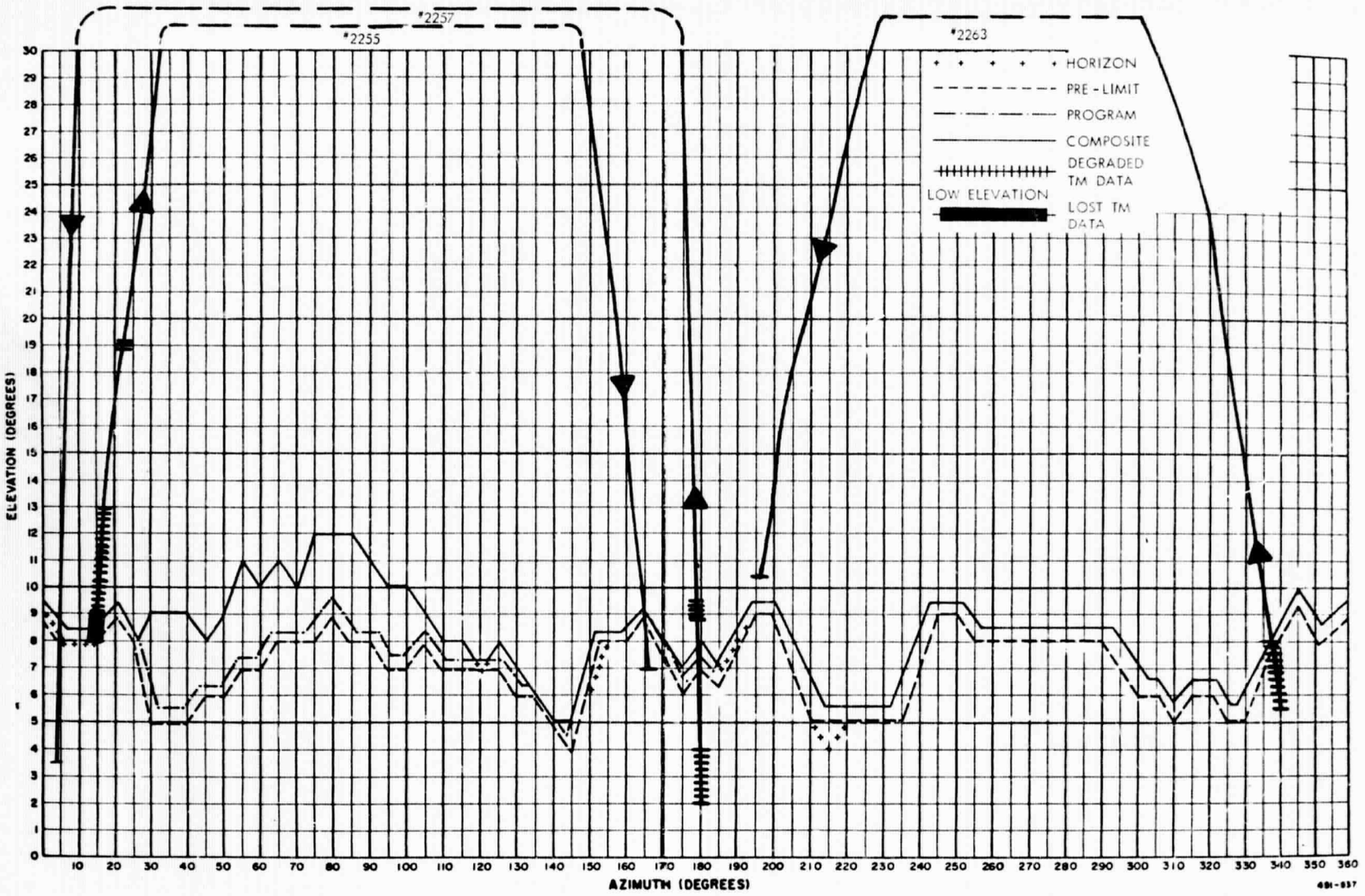

Figure 4–40-foot Dish Linear Mask (OGO-D, 64 KC R.T., Tape Nos. 2255, 2257, 2263 – SNTAGO Station).

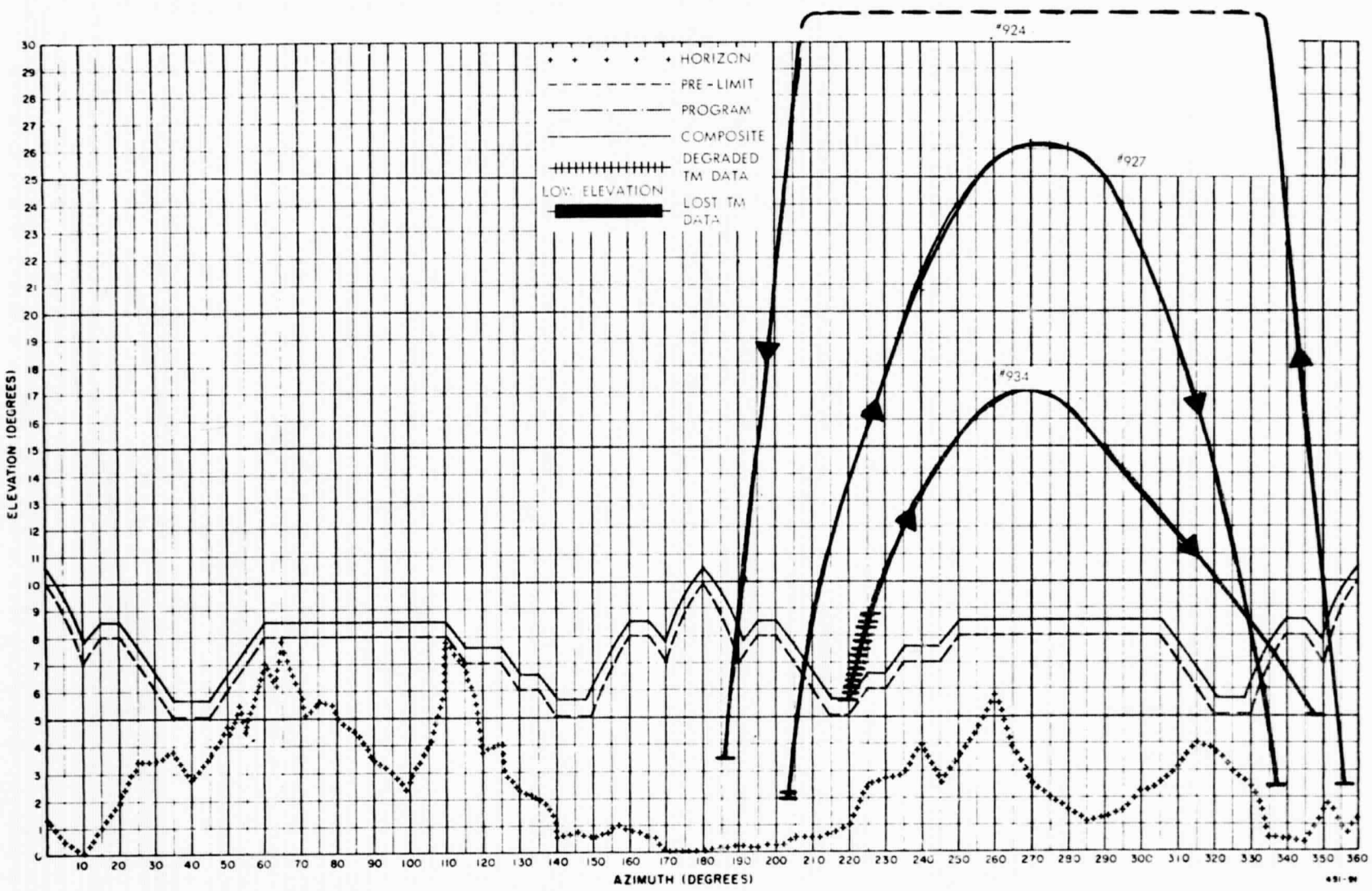

Figure 5–40-foot Dish Linear Mask (OGO-D, 64 KC R.T., Tape Nos. 924, 927, 934 – QUITOE Station).

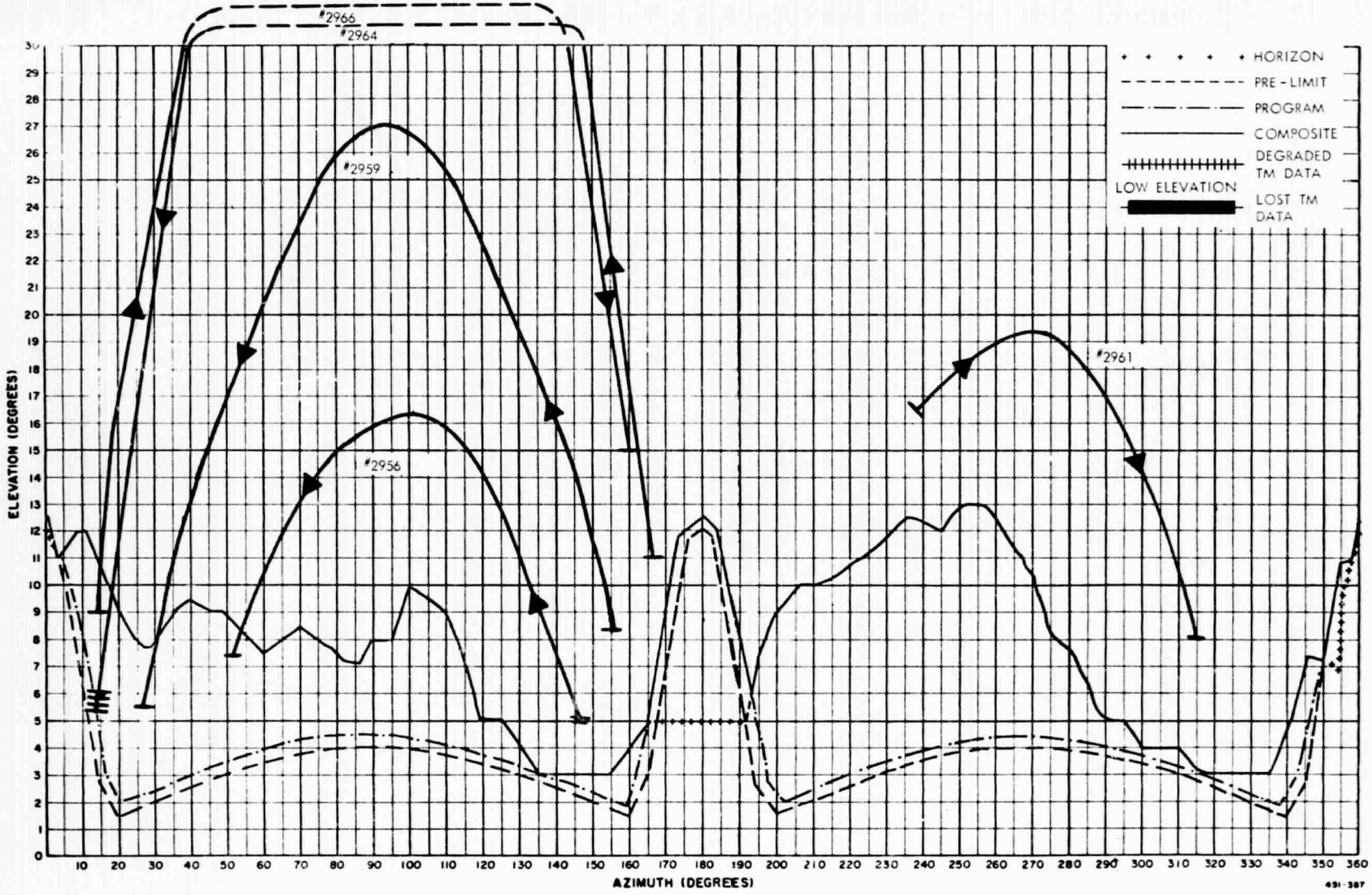

Figure 6–85-foot Dish Linear Mask (OGO-D, 64 KC R.T., Tape Nos. 2956, 2959, 2961, 2964, 2966 – ORORAL Station).

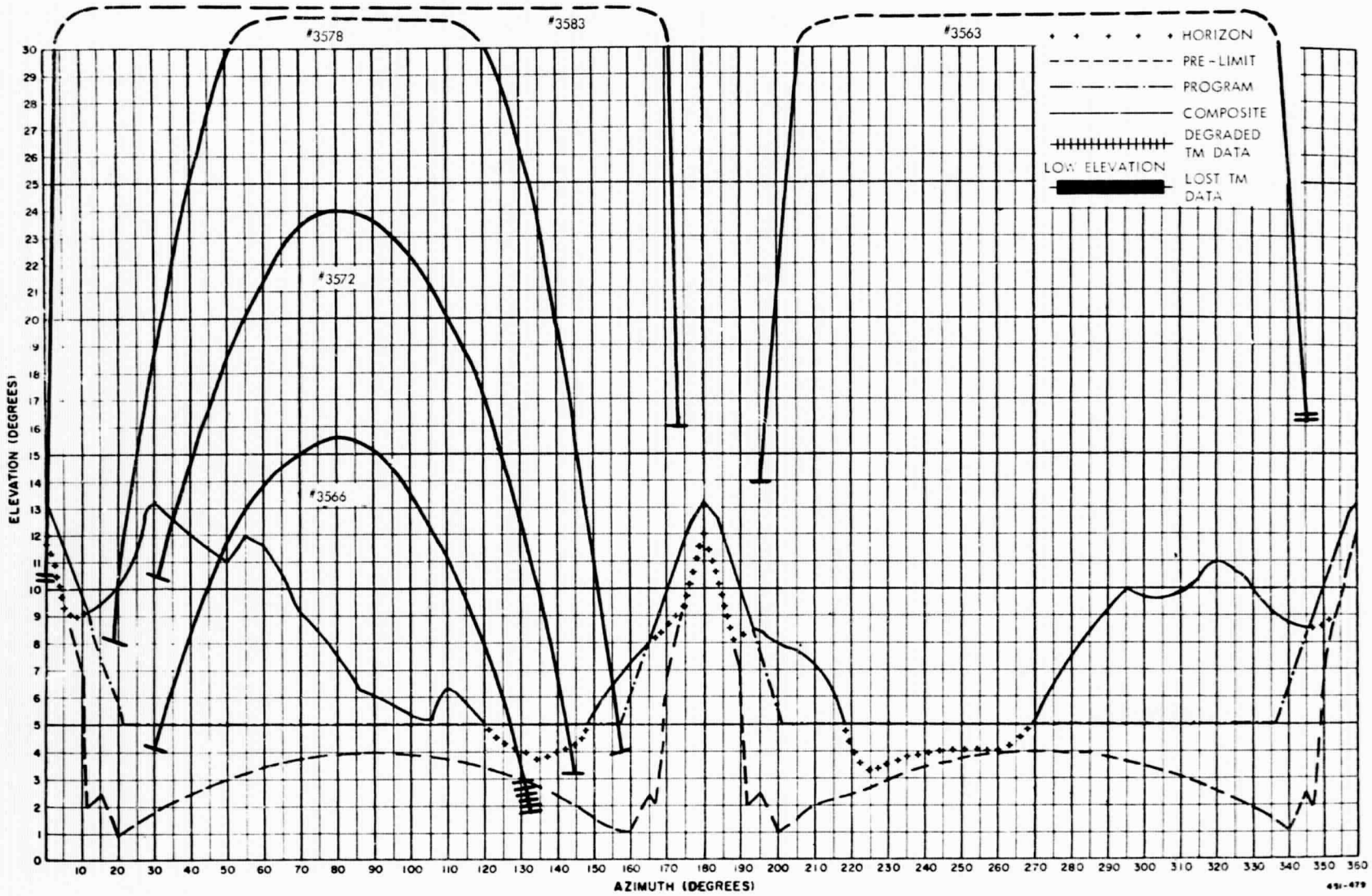

Figure 7–85-foot Dish Linear Mask (OGO-D, 64 KC R.T., Tape Nos. 3563, 3566, 3572, 3578, 3583 – ROSMAN Station).

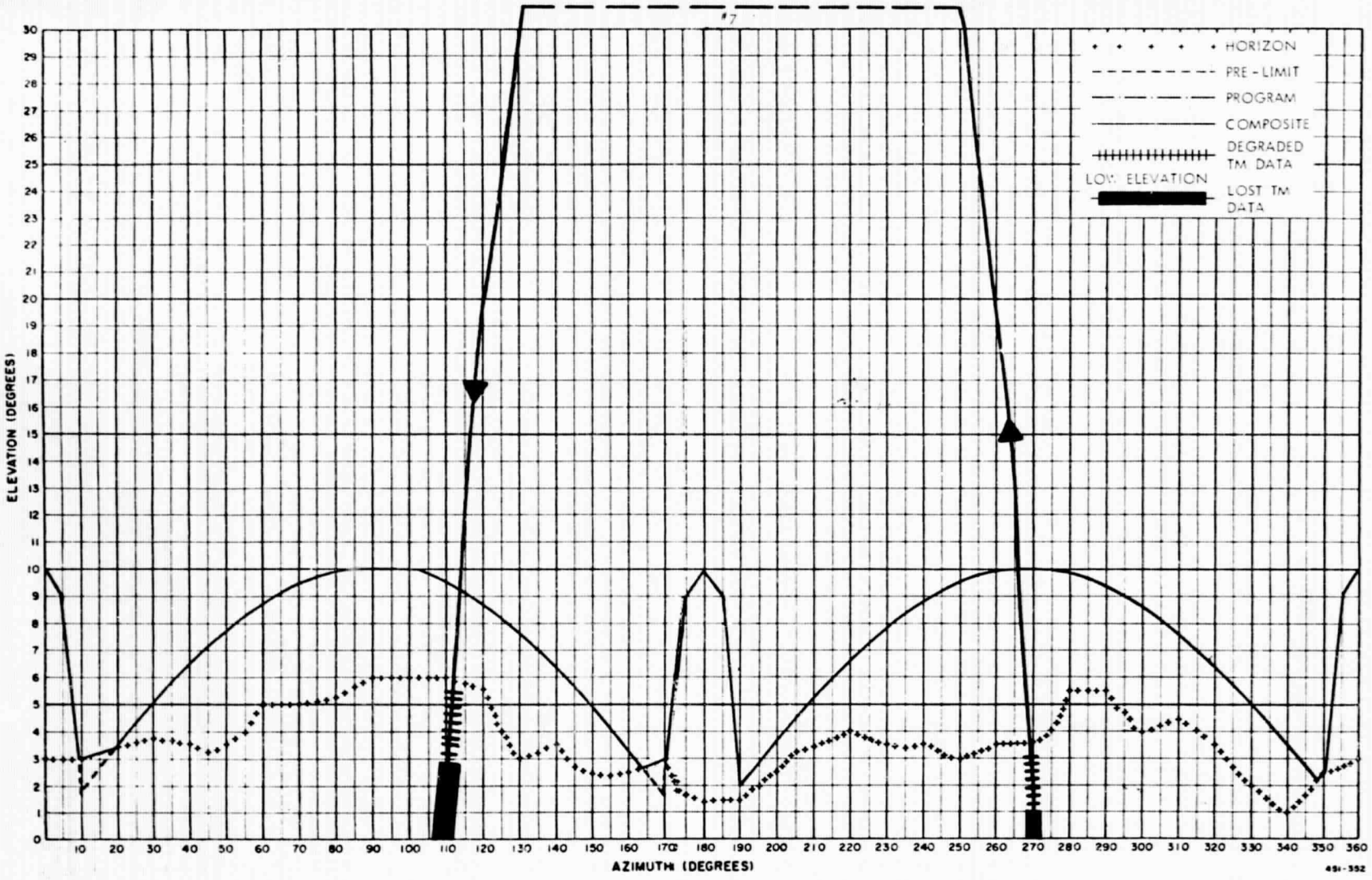

Figure 8–SATAN Receive Linear Mask (OSO-F, Tape No. 7 – MOJAVE Station).

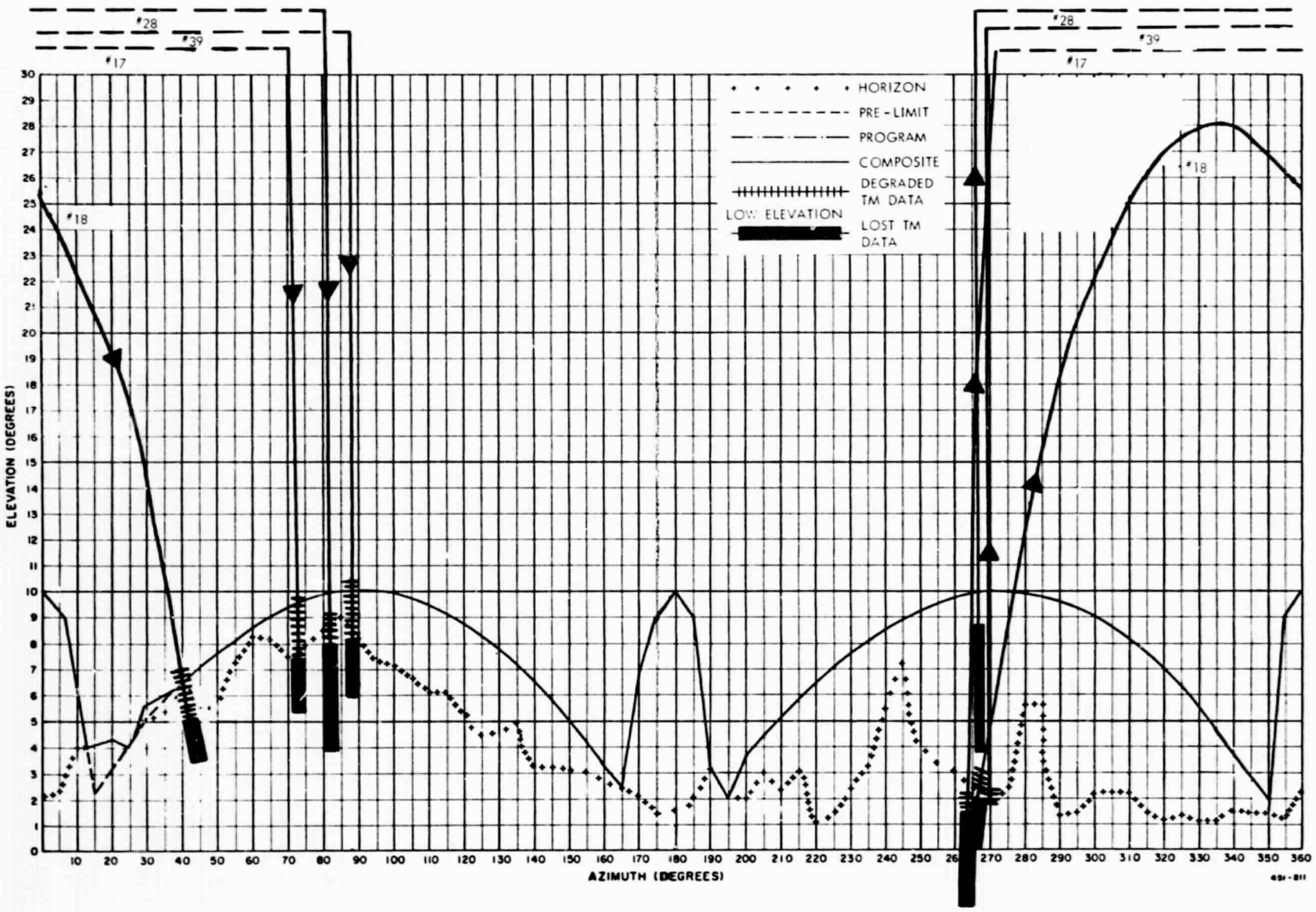

Figure 9–SATAN Receive No. 1 Linear Mask (OSO-F, Tape Nos. 17, 18, 28, and 39 – SNTAGO Station).

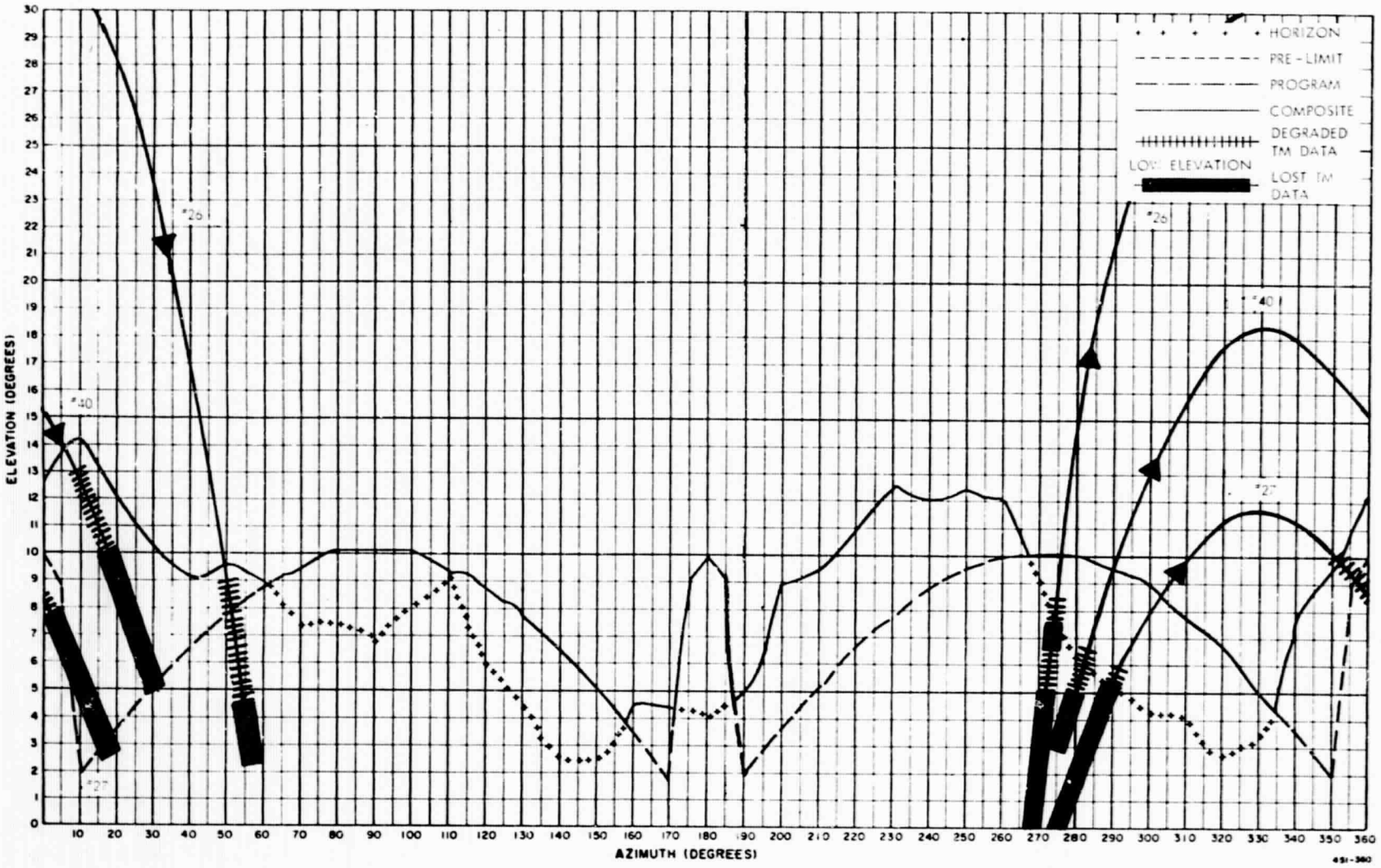

Figure 10–SATAN Receive No. 1 Linear Mask (OSO-F, Tape Nos. 26, 27, and 47 – ORORAL Station).

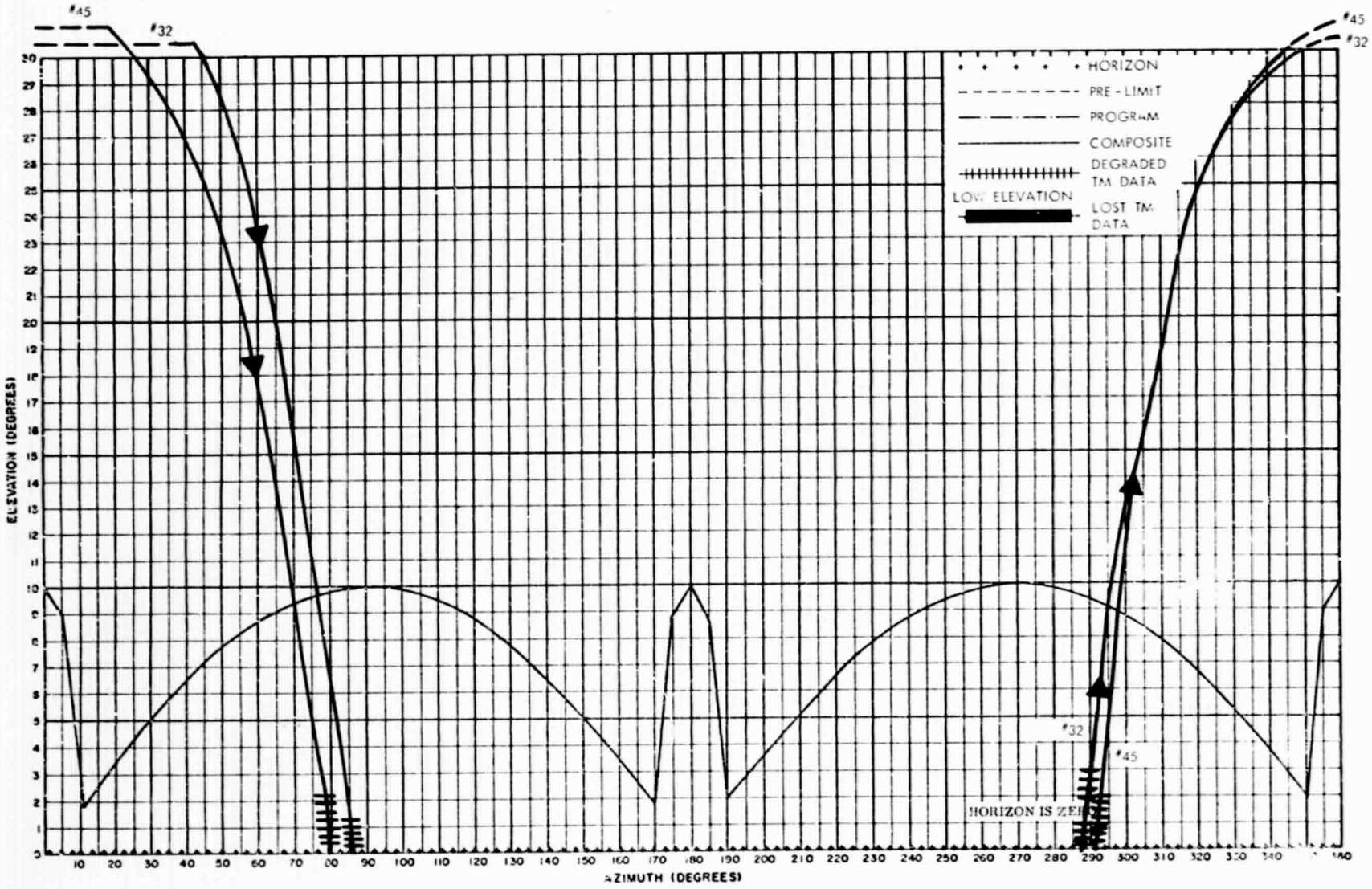

Figure 11–SATAN Receive Linear Mask (OSO-F, Tape Nos. 32 and 45 – FTMYRS Station).

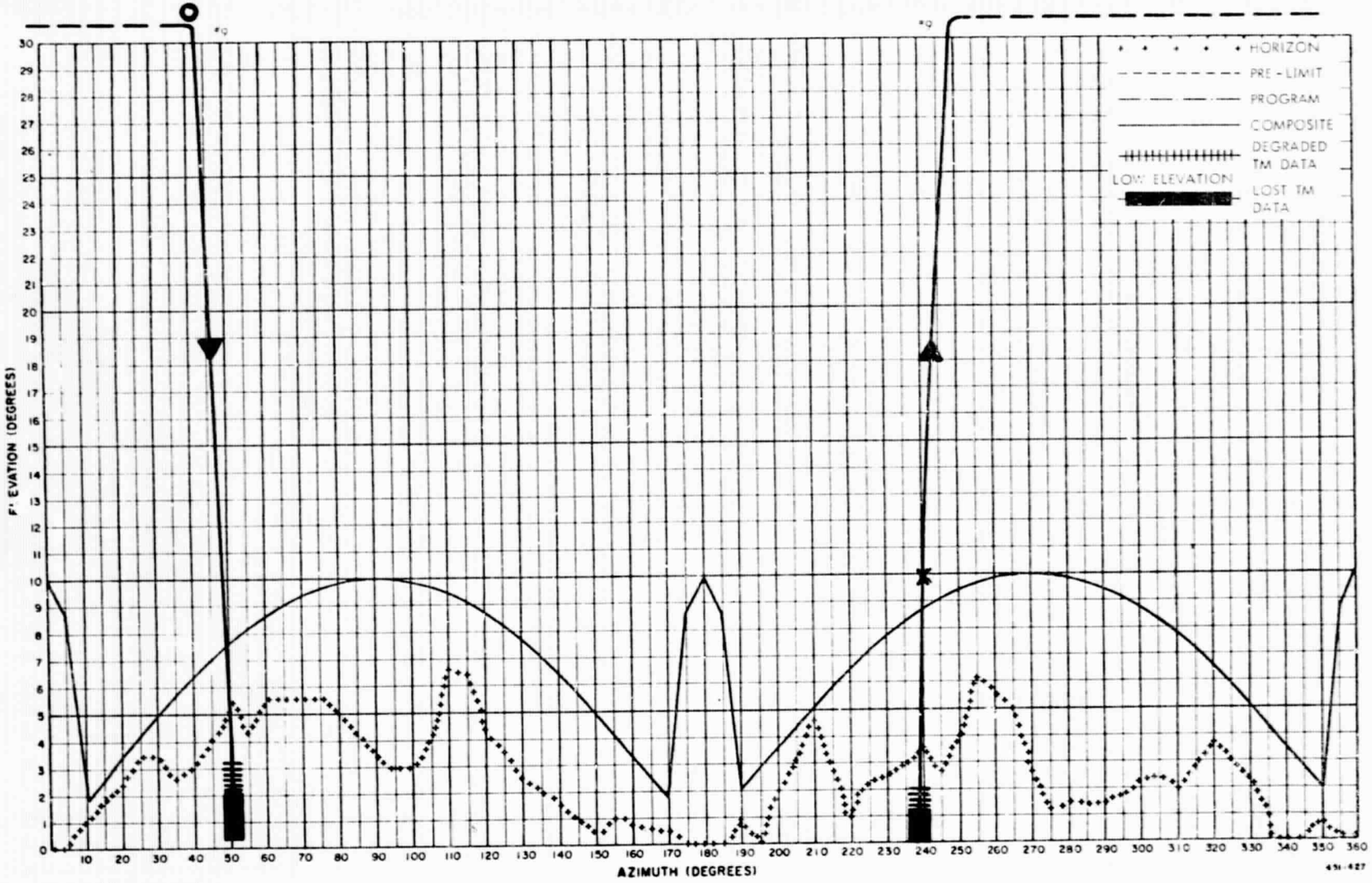

Figure 12–SATAN Receive Linear Mask (OSO-F, Tape No. 9 – QUITOE Station).

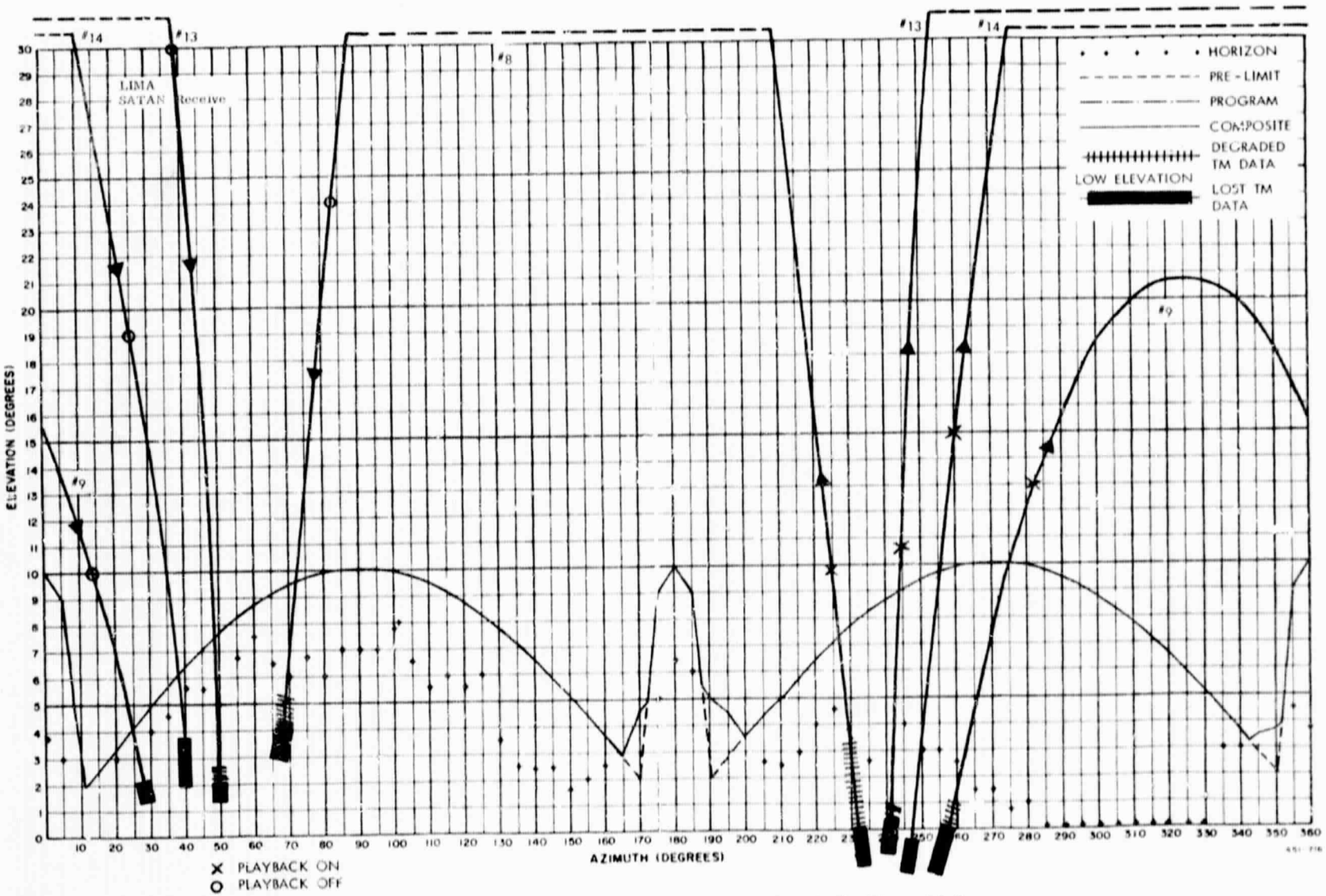

Figure 13–Lima SATAN Receive (OSO-F, Tape Nos. 8, 9, 13, and 14)

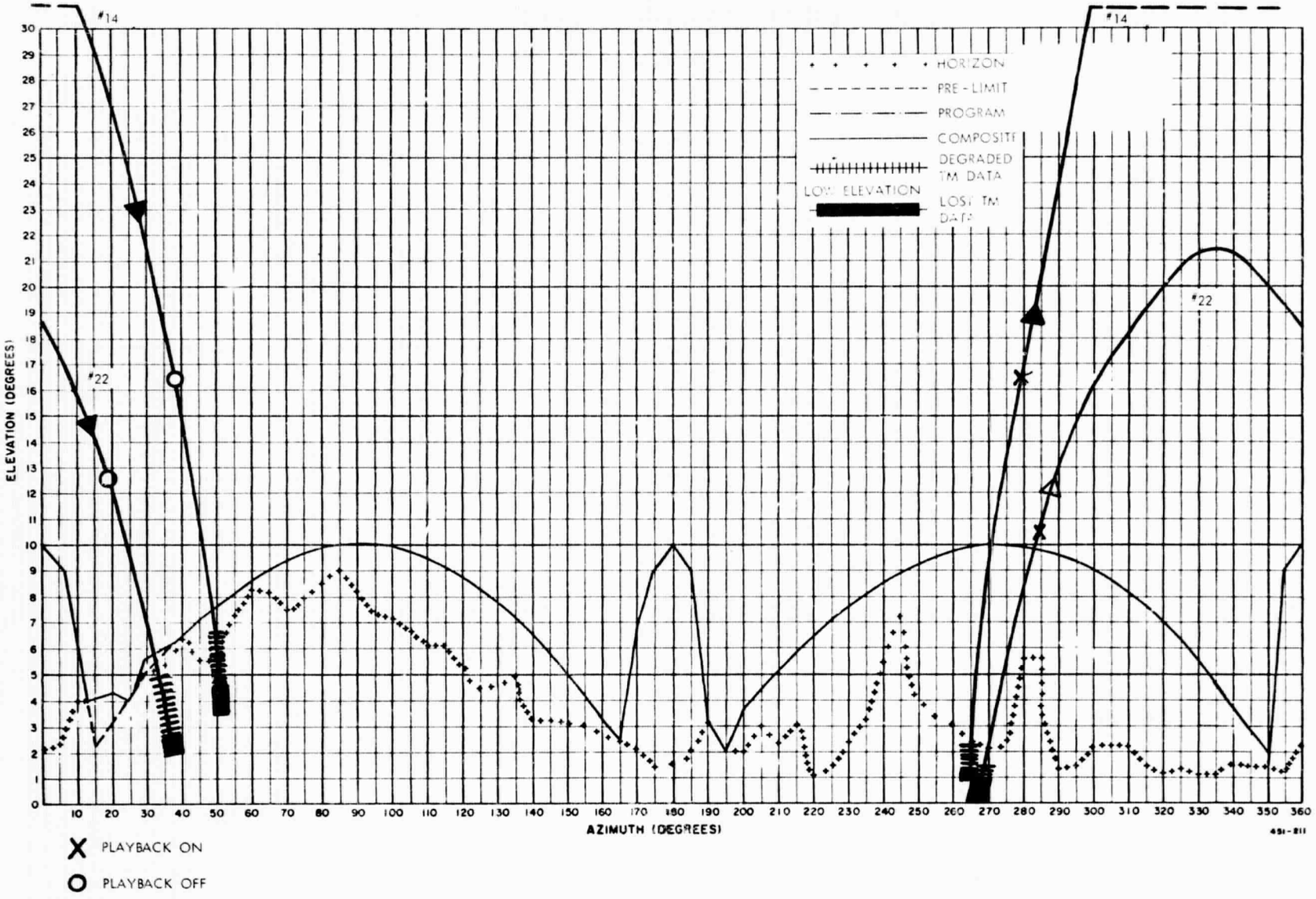

Figure 14–SATAN Receive No. 1 Linear Mask (OSO-F, Tape Nos. 14 and 22 – SNTAGO Station).

The antenna linear mask plots for each antenna type and station contain the horizon, antenna structural prelimits, and antenna drive computer program profiles.

One can easily observe the degraded or lost telemetry data intervals at the low elevations angles for each antenna profile type (i.e., horizon, pre-limit, and program).

V. CONCLUSIONS

This report indicates that for low elevation tracking angles the data recovery and data quality are degraded almost beyond use. The present philosophy is for each station to acquire as much data as possible during the pass. Consideration should be given to only acquiring data of acceptable quality to STADAN, IPD, and experimenters. It is the authors' recommendations that the scheduling of passes be revised so that this improvement in acquisition and data processing can be achieved.

Since low evaluation angle tracking is a predominant noise source, the following conclusions have been reached:

- STADAN link efficiency can be improved by scheduling data collection above horizon data quality limits (to be determined by IPD's data processing quality "profile").
- IPD computer/processing line efficiency can be increased by processing only meaningful data at high elevation angles.
- IPD programs can be simplified by removing data recovery subroutines for extremely low signal-to-noise ratio at beginning and end of pass.
- Experimenter software programs can be simplified by allowing IPD to furnish only virtually error free data (bit error rate $<10^{-6}$).
- Total system improvement and confidence will result by only processing high-quality data where possible (assuming project requirements can be met through scheduling high elevation, greater than 10°, passes).
- More realistic link evaluation and performance monitoring would result by removing low elevation "biased" system errors.

ACKNOWLEDGMENTS

The authors acknowledge Mr. Earl C. Gernert for implementing the PCM Performance Monitor and Mr. William Withgoth, tape evaluation group leader, C&S, Inc., for his support in reconfiguring the IPD E-5 line to accommodate the performance monitor.

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1. STADAN Space Oriented, Steerable Antenna Profiles Volumns One and Two, November 1968, Goddard Space Flight Center.

APPENDIX A

Tape Evaluation Strip Charts for OGO-D

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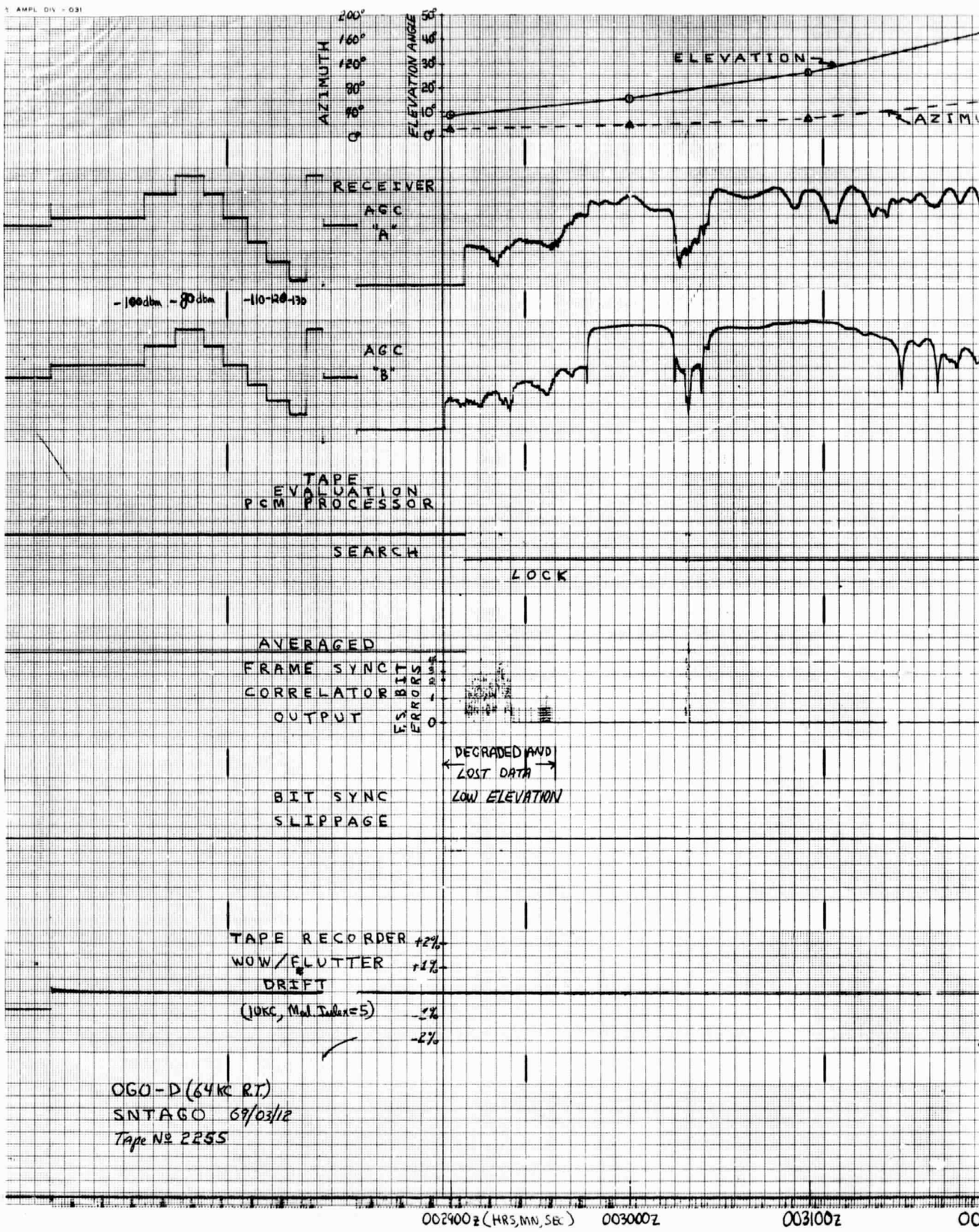

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Figure A-1-

Figure A-1—IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data; SNTAGO, Tape No. 2255

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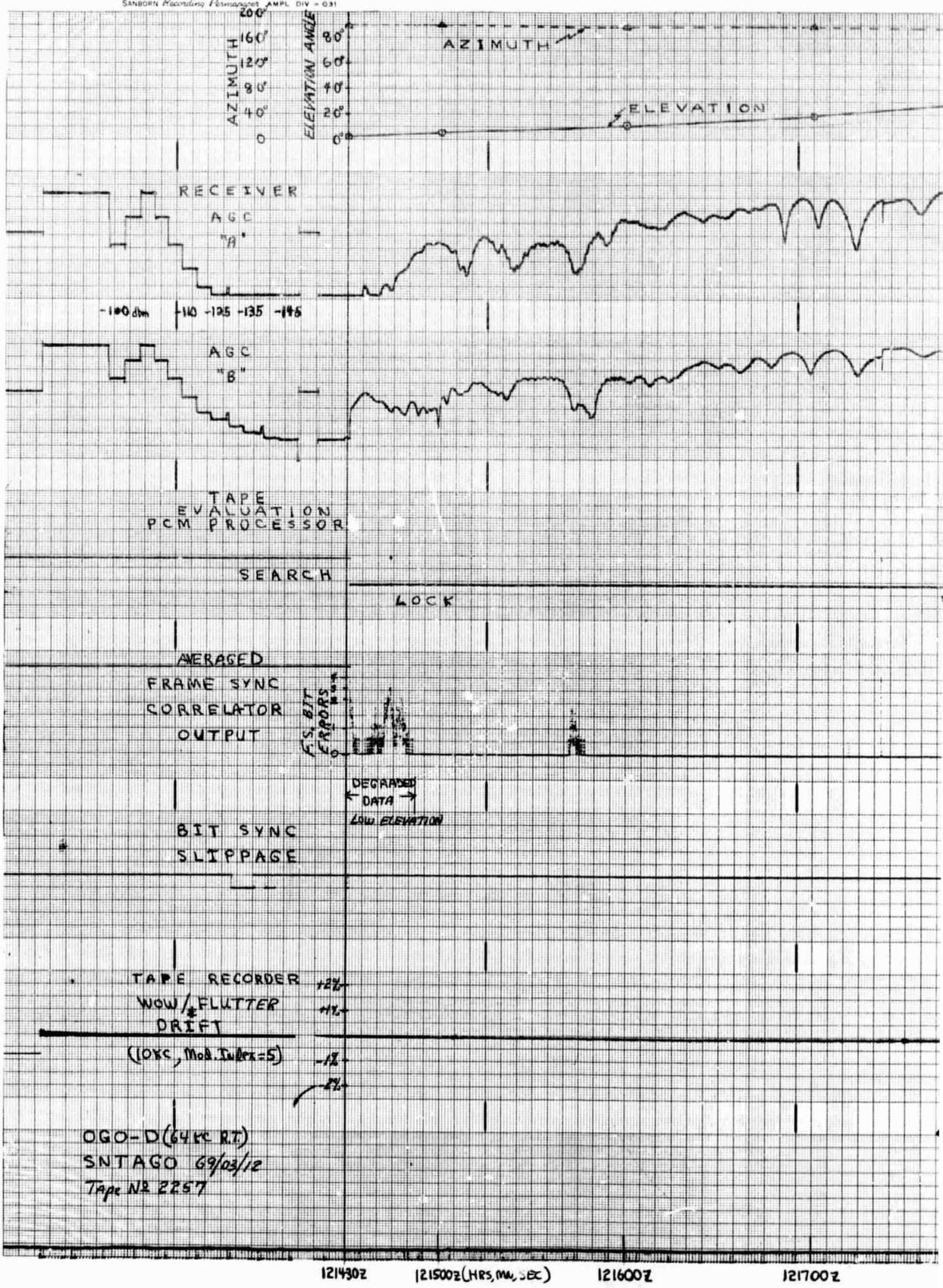

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Figure A-2–IPD's Strip Chart Analysis of OGO-D

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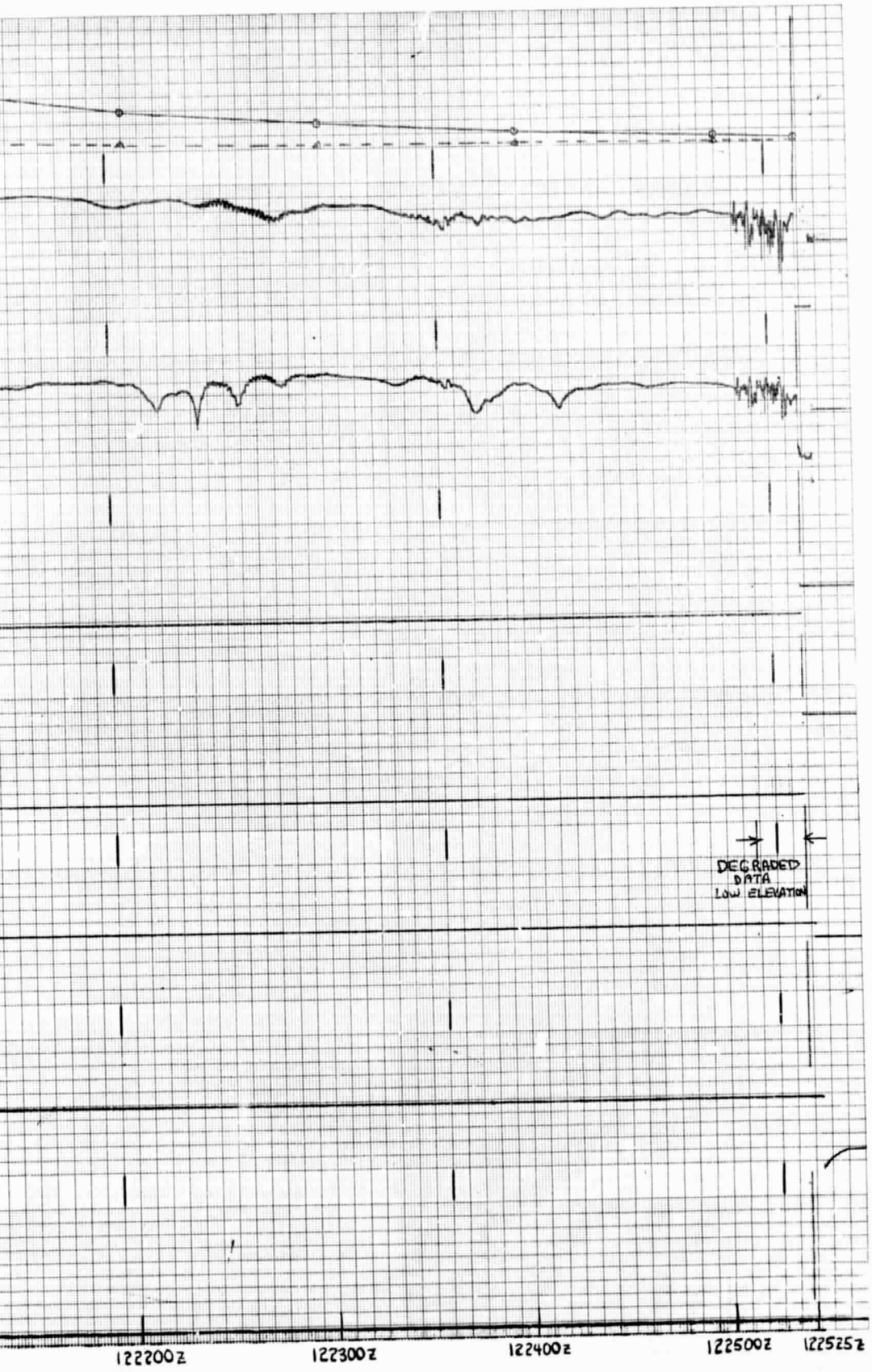

PD's Strip Chart Analysis of OGO-D 64 KC R.T. Data; SNTAGO, Tape No. 2257

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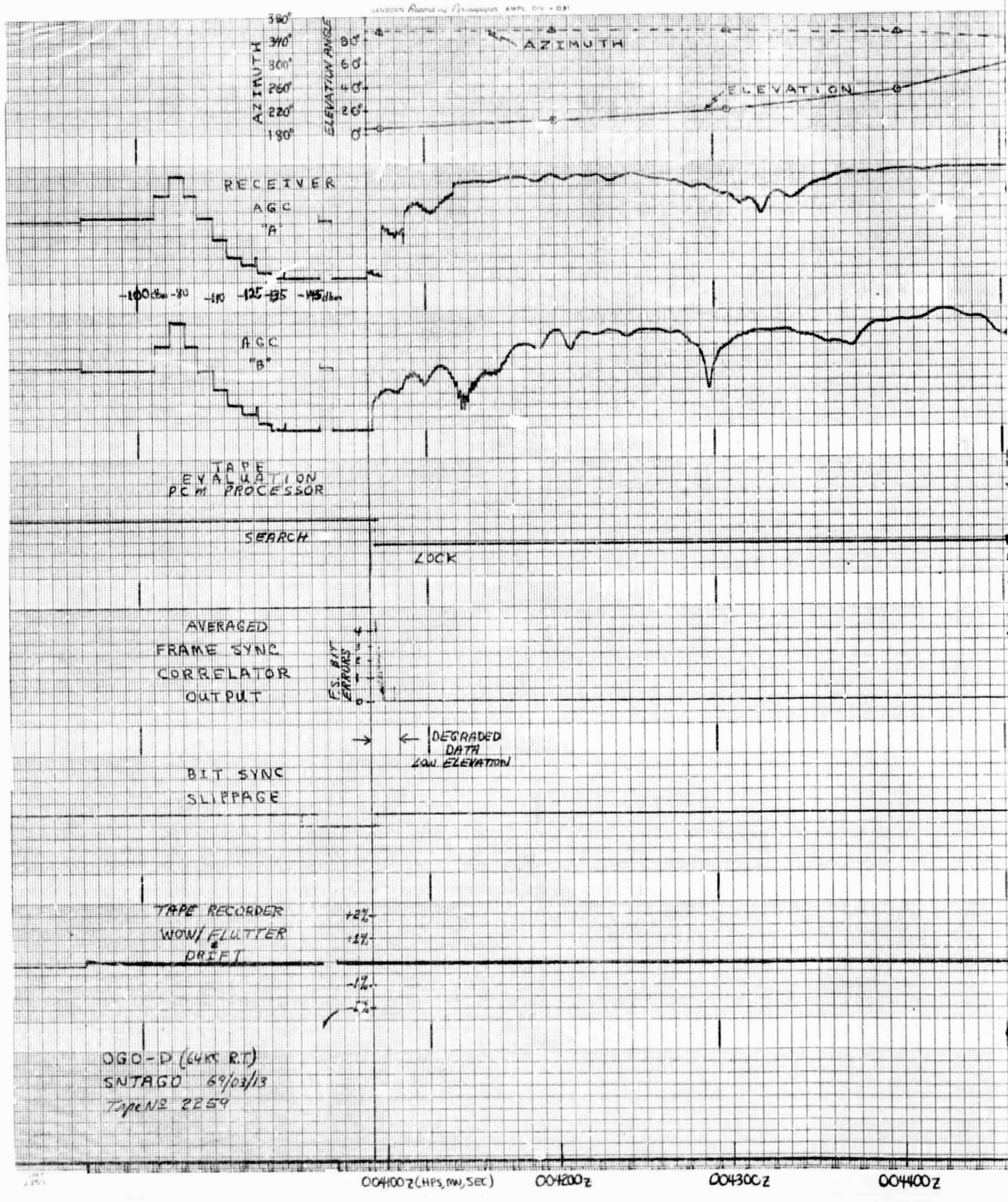

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Fig

Figure A-3—IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data; SNTAGO, Tape No. 2259

FOLDOUT FRAME 2

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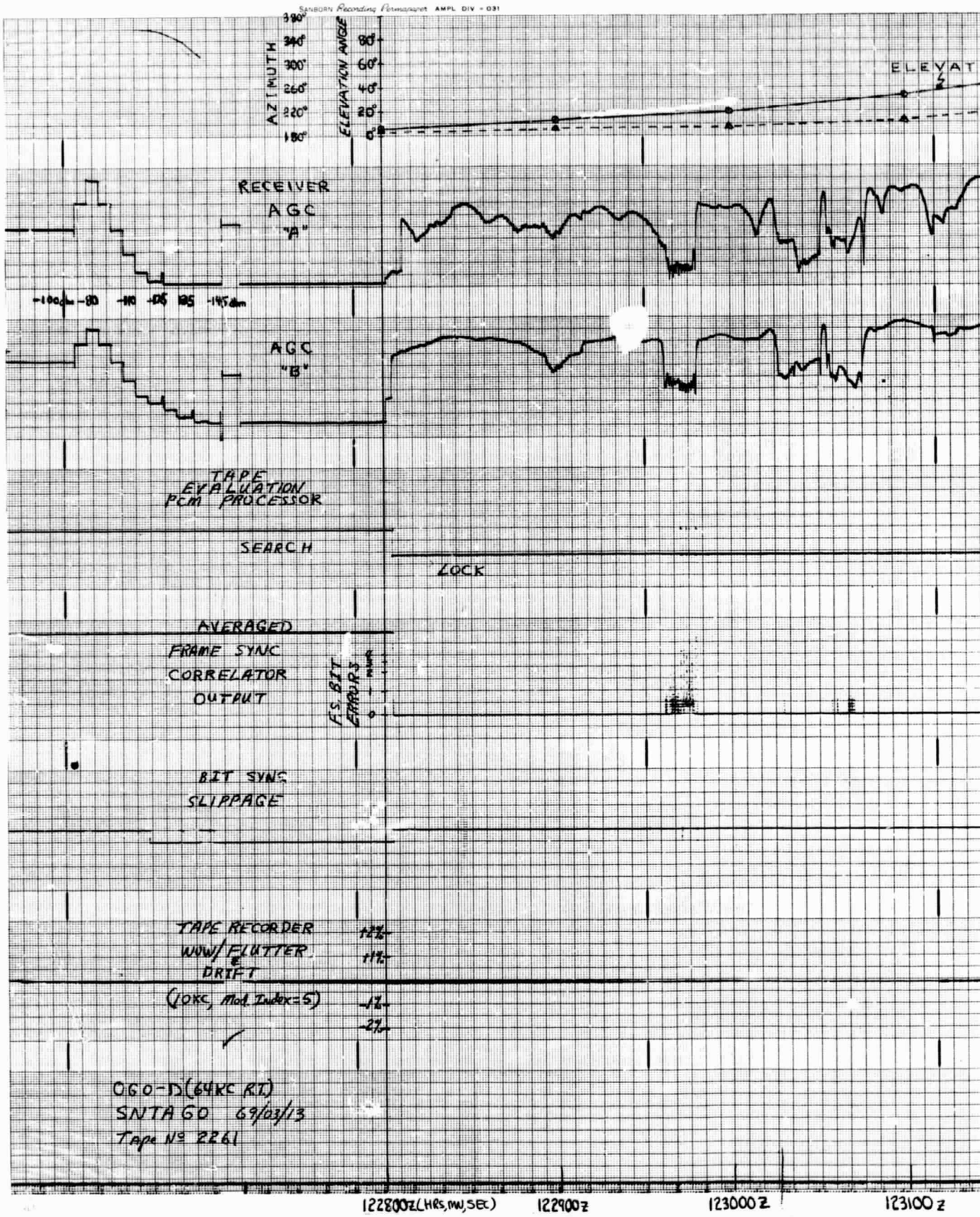
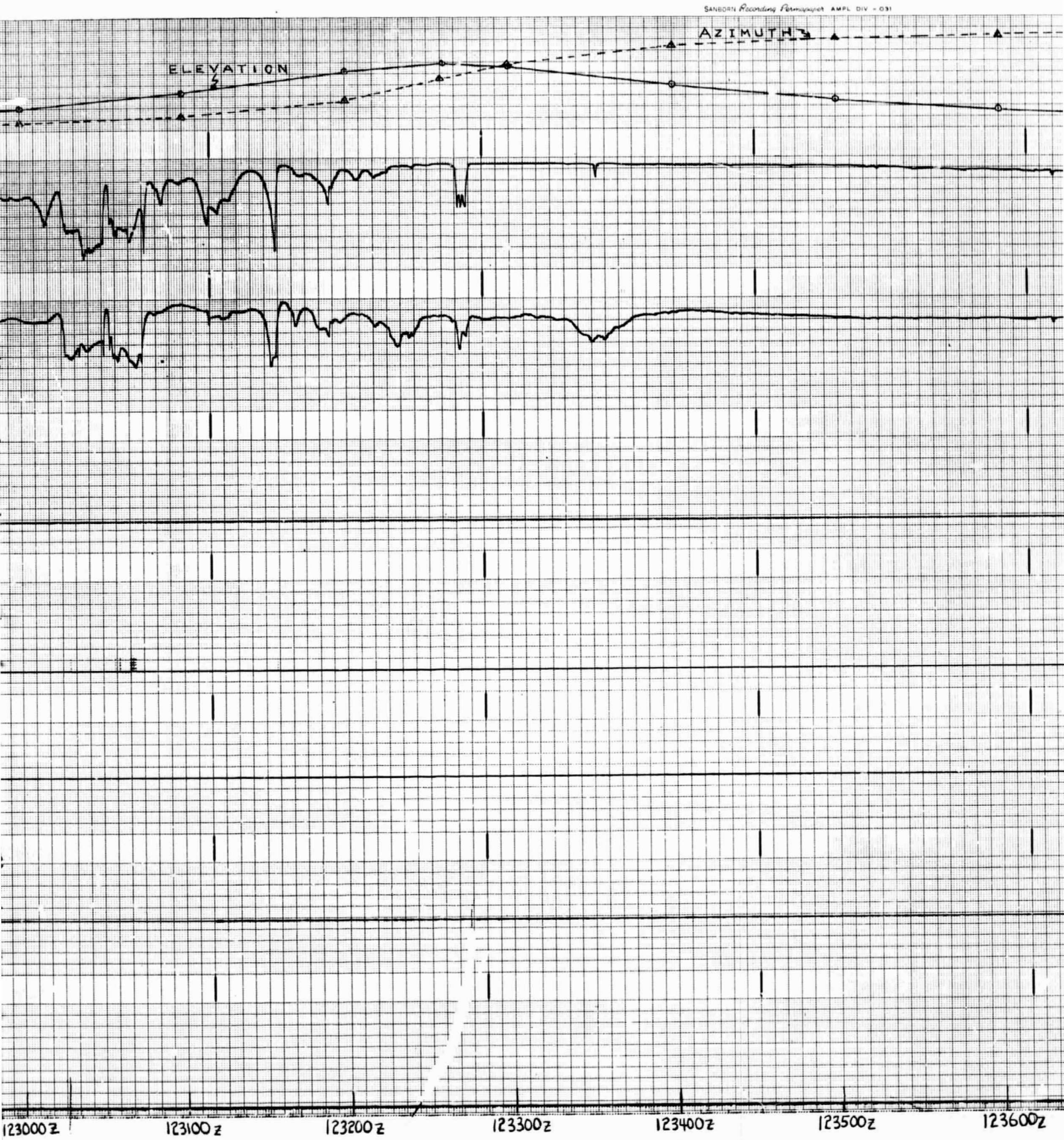


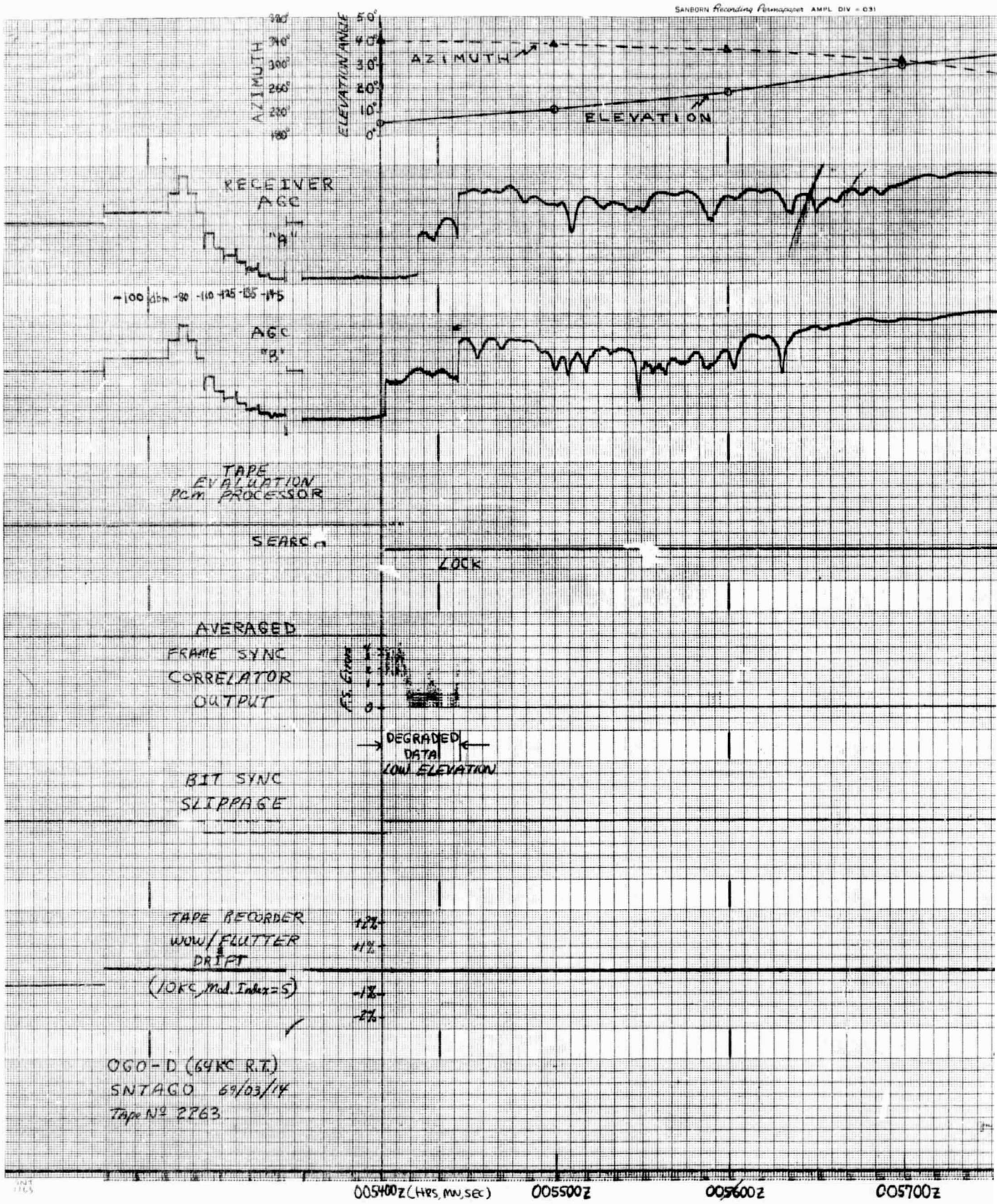
FOLDOUT FRAME 1



FOLDOUT FRAME 2 Figure A-4—IPD's Strip Chart Analysis of OGO-D 64 KC

e A-4-IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data, SNTAGO, Tape No. 2261

FOLDOUT FRAME 3



FOLDOUT FRAME

Figure A-5—IPD's Str

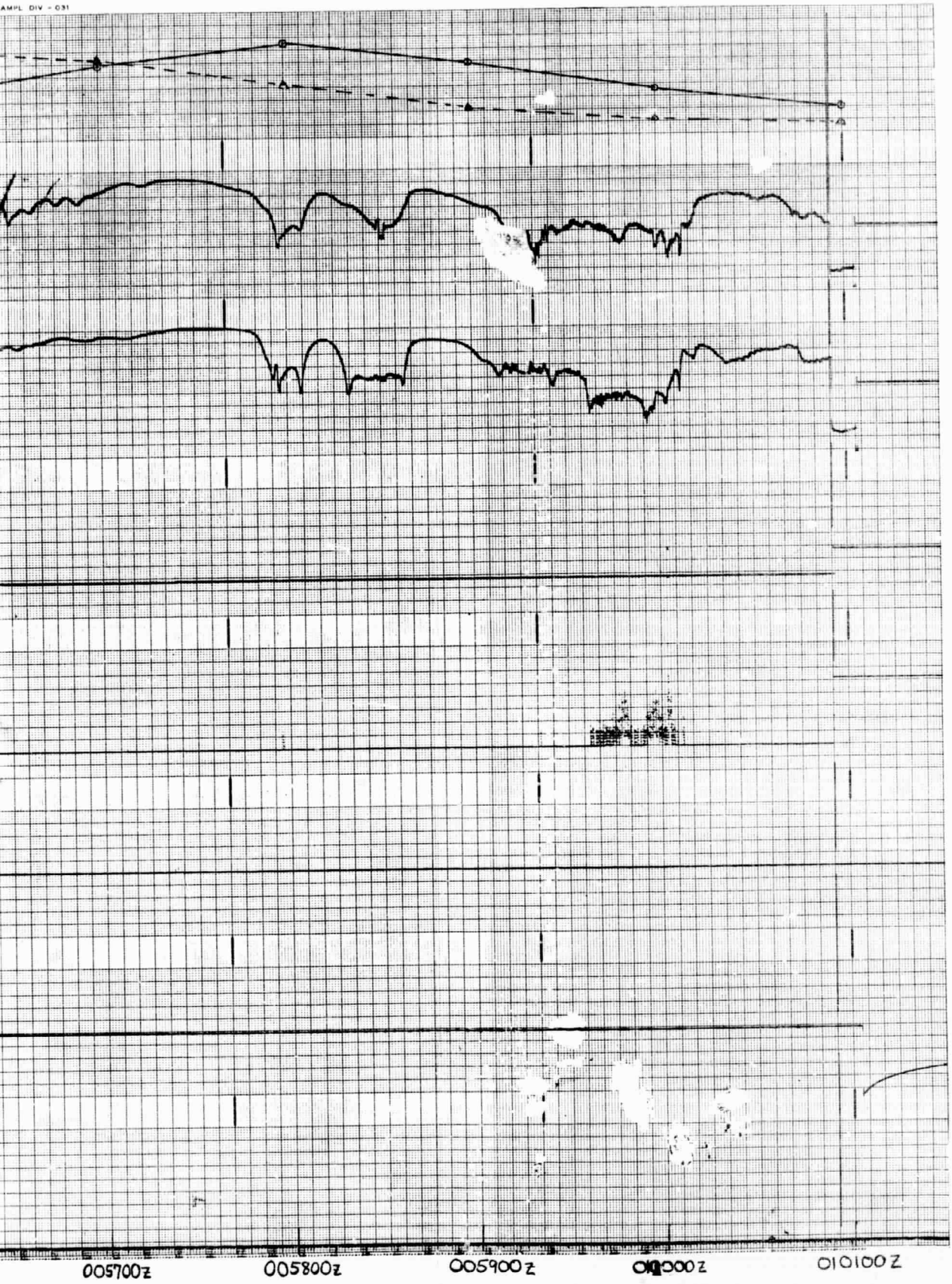
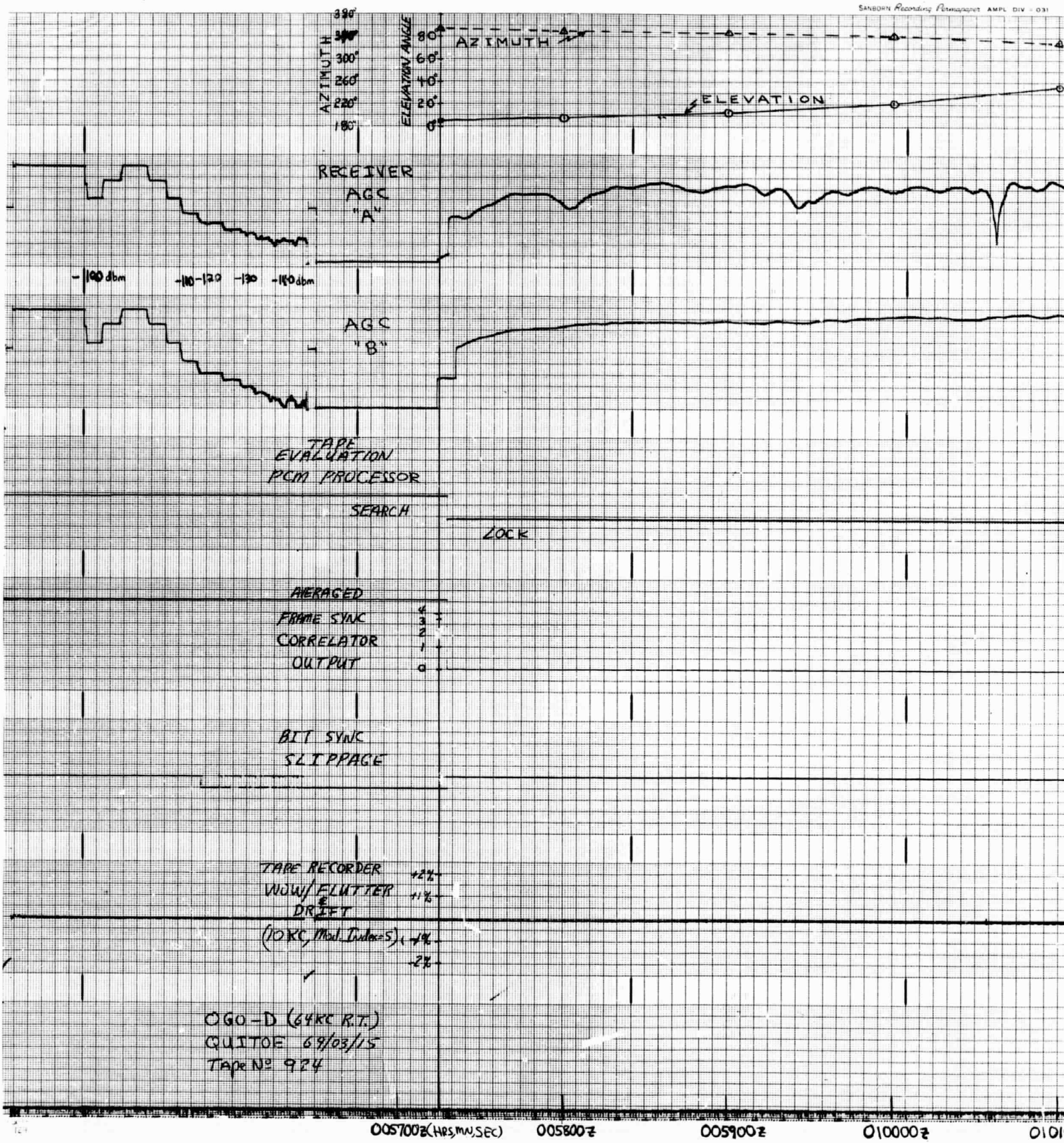


Figure A-5—IPD's Strip Chart Analysis of OCO-D 64 KC R.T. Data; SNTAGO, Tape No. 2263

FOLDOUT FRAME



FOLDOUT FRAME

FOLDOUT FRAME

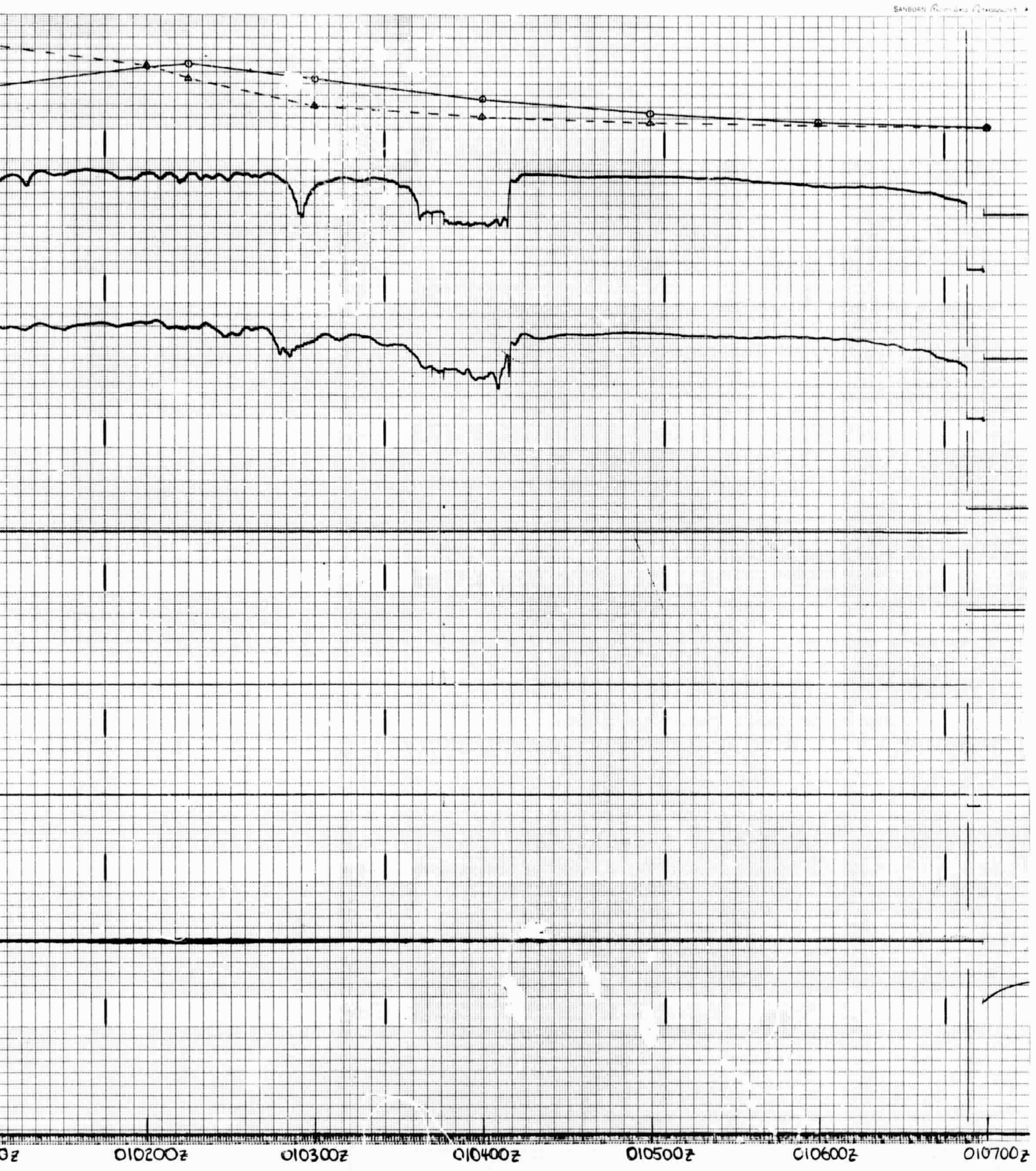


Figure A-6–IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data; QUITOE, Tape No. 924

FOLDOUT FRA

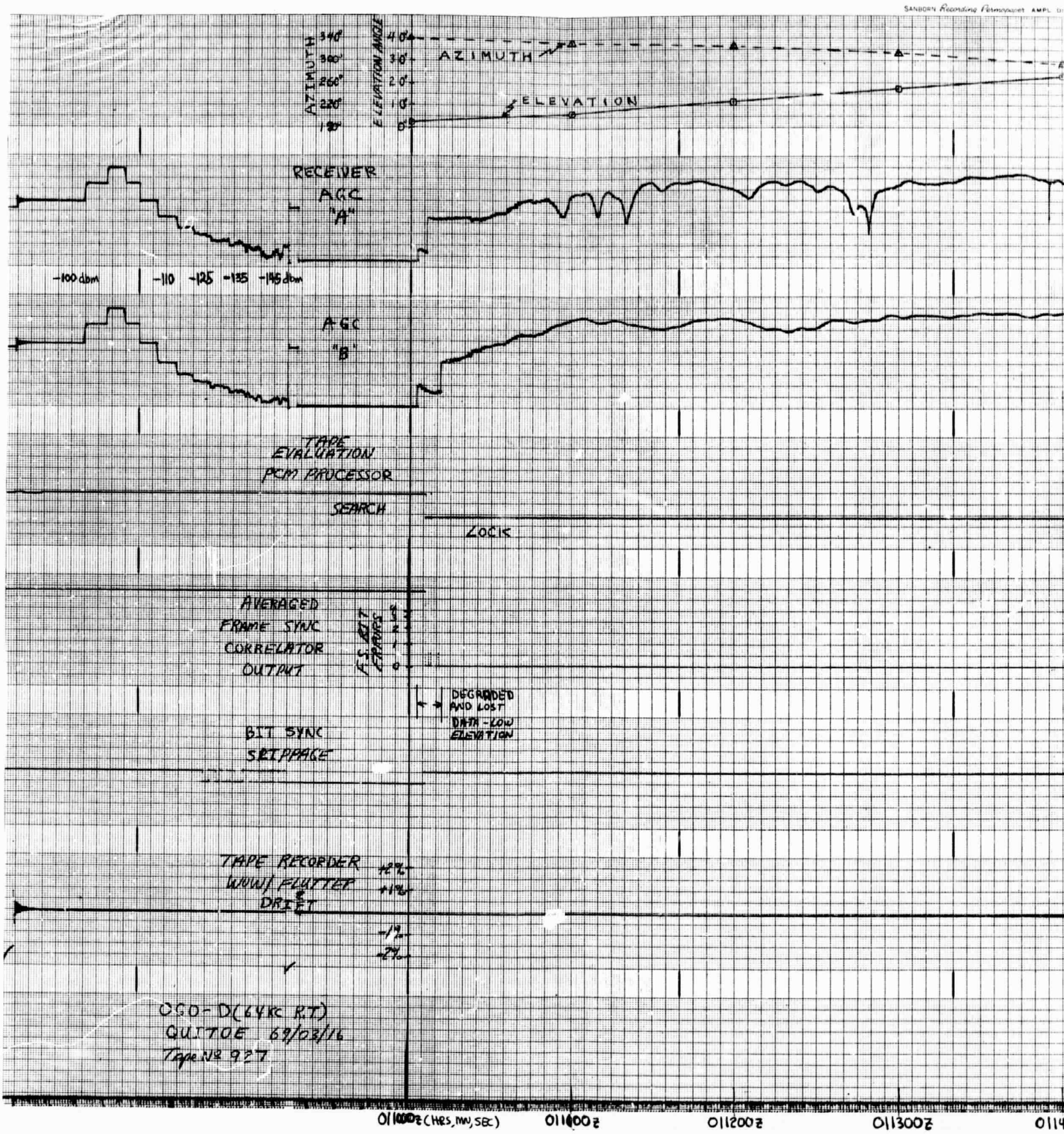

SANBORN Recording Permanent AMPL
AZIMUTH
ELEVATION ANGLE
AZIMUTH
ELEVATION
RECEIVER AGC "A"
-100 dbm
-110
-125
-135
-145 dbm
AGC "B"
TAPE EVALUATION PCM PROCESSOR
SEARCH
LOCK
AVERAGED FRAME SYNC CORRELATOR OUTPUT
F.S. BIT ERRORS
DEGRADED AND LOST DATA - LOW ELEVATION
BIT SYNC SLIPPAGE
TAPE RECORDER WOW & FLUTTER DRIFT
CGO-D(64KC R.T)
QUITOE 69/03/16
Tape Nº 927
011000Z (HRS, MN, SEC)
011100Z
011200Z
011300Z

Figure A-7—IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data; QUITOE, Tape No. 927

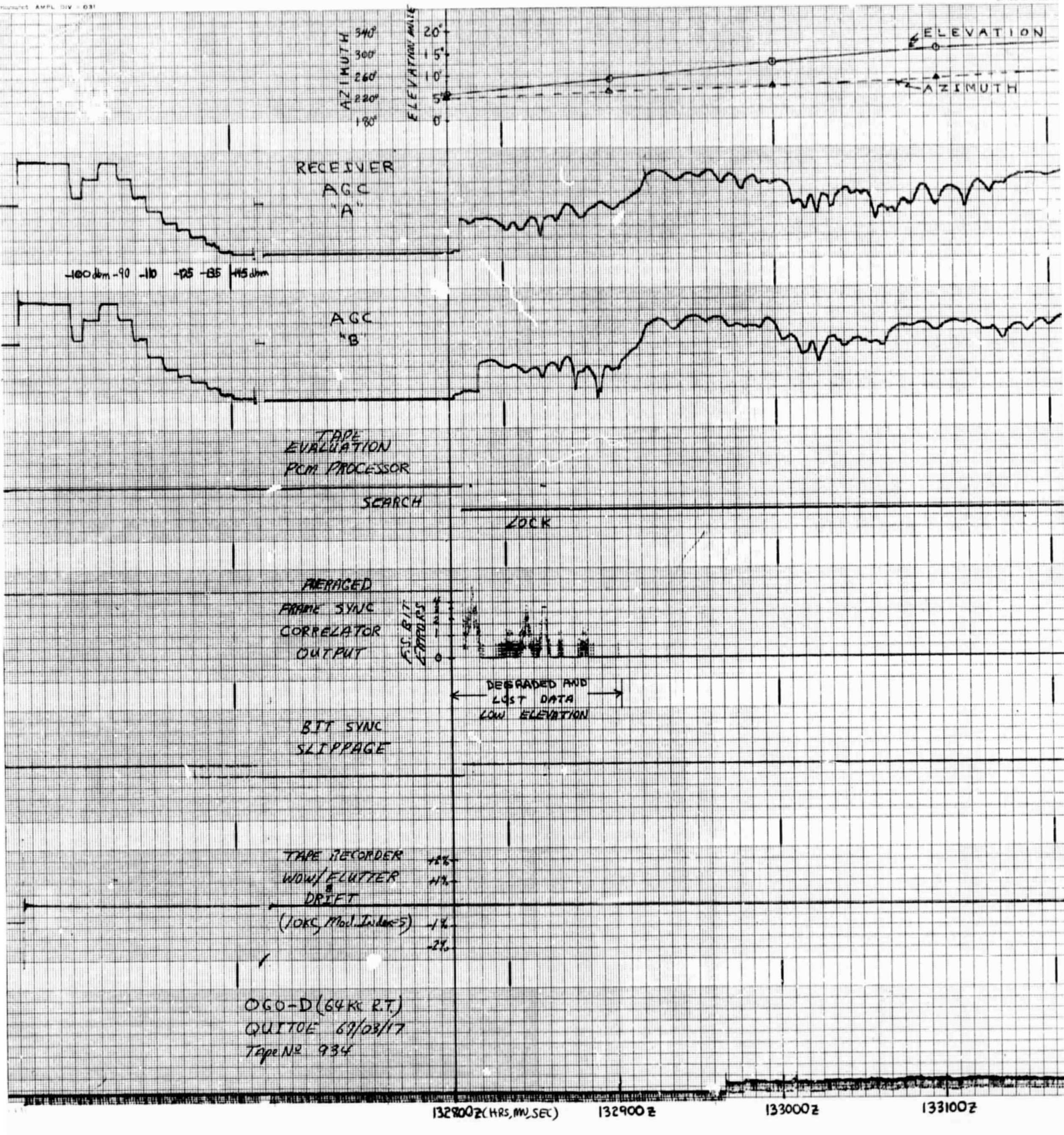
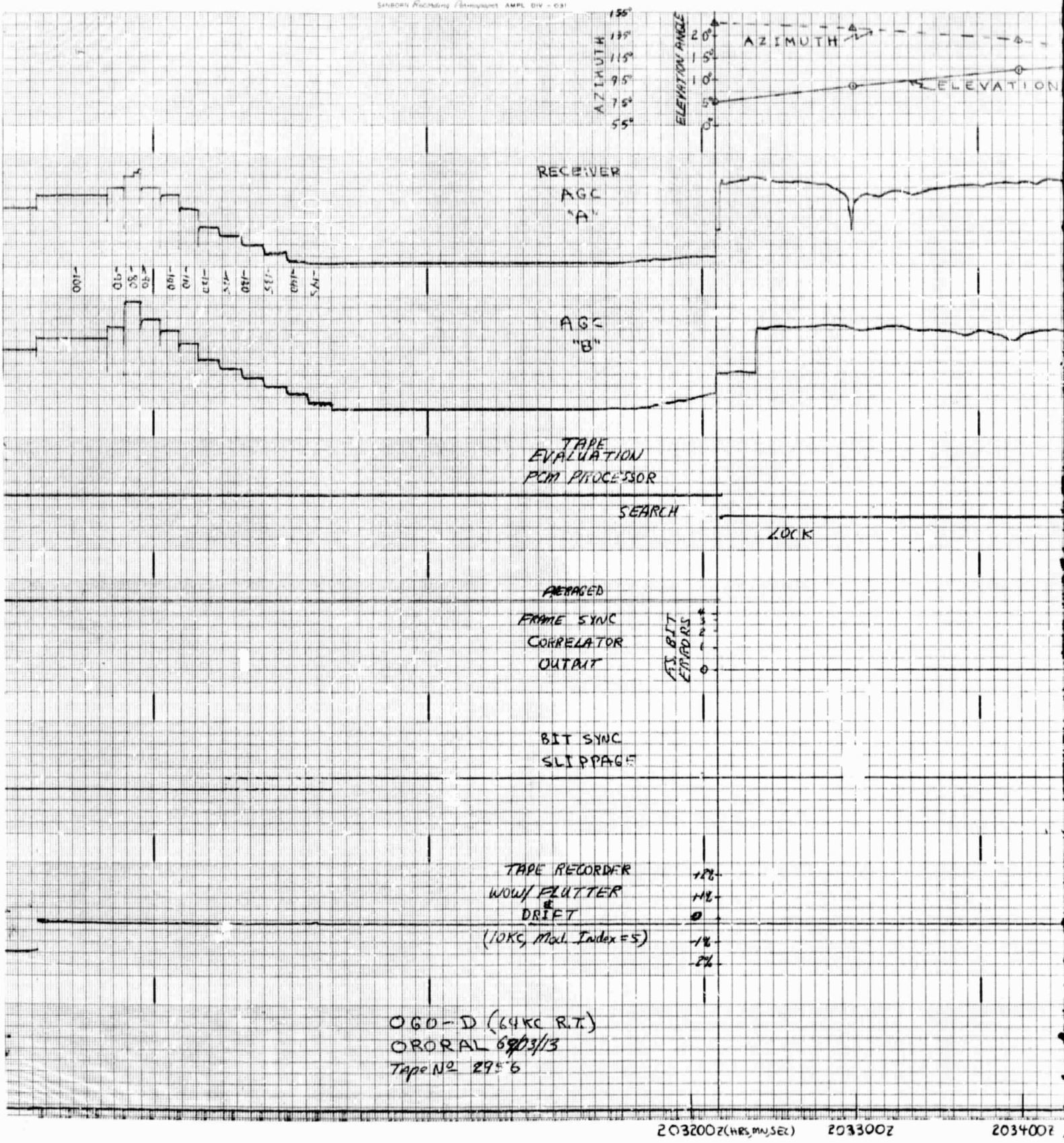

AZIMUTH
340°
300°
260°
220°
180°
ELEVATION ANGLE
20°
15°
10°
5°
0°
ELEVATION
AZIMUTH
RECEIVER AGC "A"
-100 dbm -90 -110 -125 -135 -145 dbm
AGC "B"
TAPE EVALUATION PCM PROCESSOR
SEARCH
LOCK
AVERAGED FRAME SYNC CORRELATOR OUTPUT
BIT SYNC ERRORS
DEGRADED AND LOST DATA LOW ELEVATION
BIT SYNC SLIPPAGE
TAPE RECORDER WOW & FLUTTER DRIFT
(10KC, Mod. Index=5)
+2%
+1%
-1%
-2%
OGO-D (64 KC R.T.)
QUITOE 69/03/17
Tape Nº 934
132800Z (HRS, MN, SEC)
132900Z
133000Z
133100Z

Figure A-8-IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data; QUITOE, Tape No. 934


AZIMUTH
155°
135°
115°
95°
75°
55°
ELEVATION ANGLE
20°
15°
10°
5°
0°
AZIMUTH
ELEVATION
RECEIVER AGC "A"
AGC "B"
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
TAPE EVALUATION PCM PROCESSOR
SEARCH
LOCK
AVERAGED FRAME SYNC CORRELATOR OUTPUT
FS BIT ERRORS
5
4
3
2
1
0
BIT SYNC SLIPPAGE
TAPE RECORDER WOW & FLUTTER & DRIFT
(10KC, Mod. Index = 5)
+2%
+1%
0
-1%
-2%
OGO-D (64KC R.T.)
ORORAL 6803/13
Tape No. 2956
2032002 (HRS, MN, SEC)
2033002
2034002

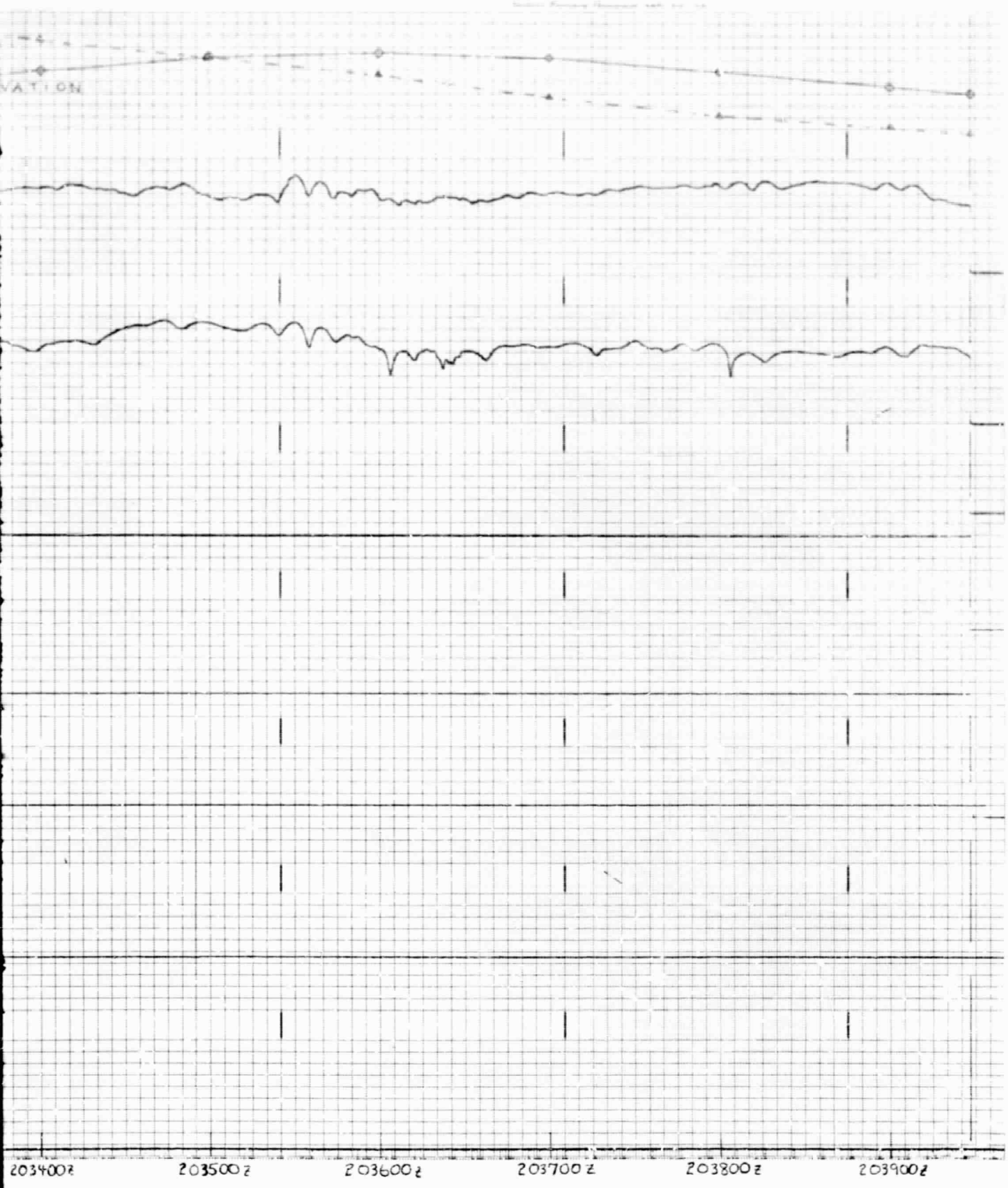
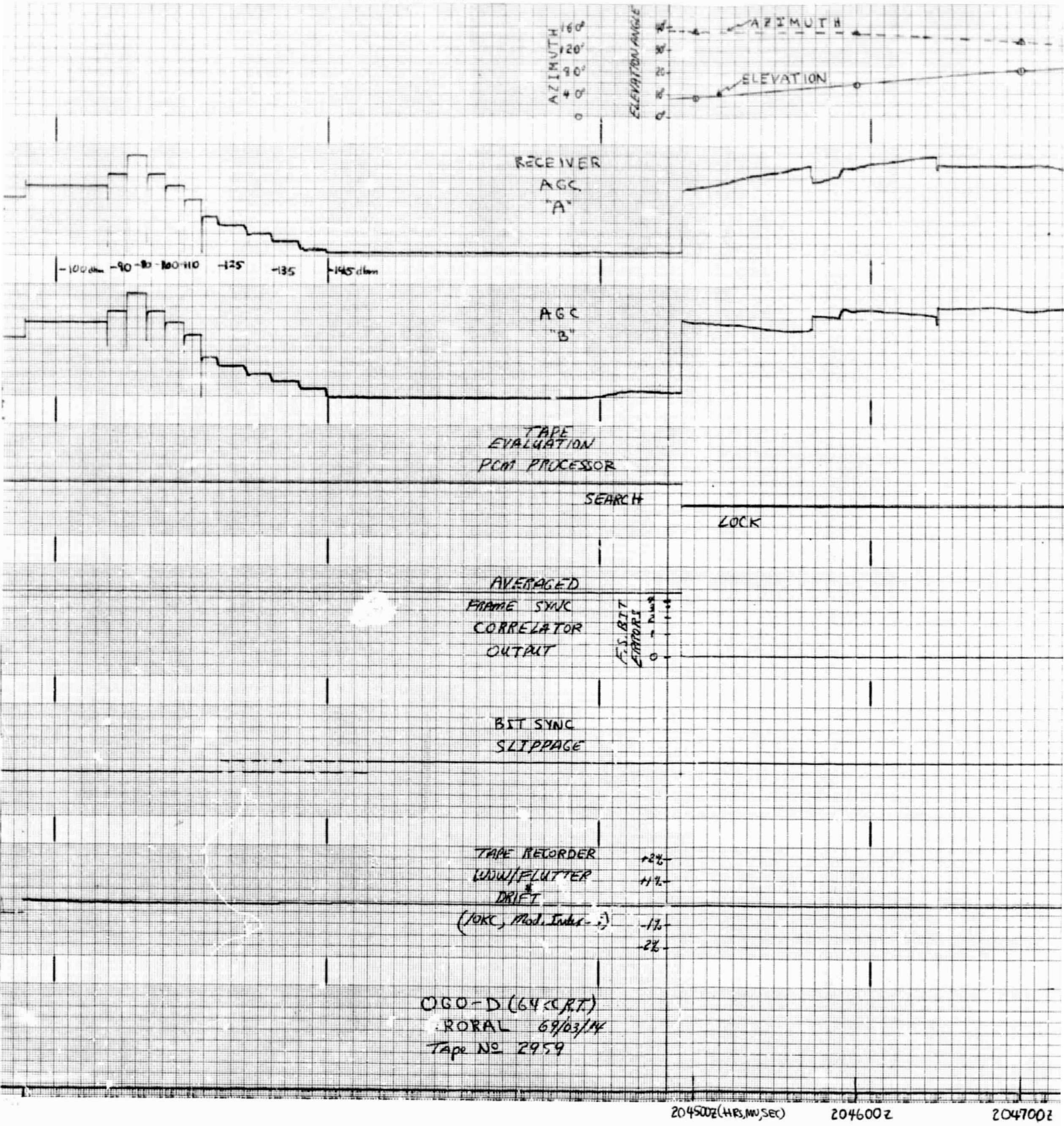


Figure A-9—IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data; ORORAL, Tape No. 2956

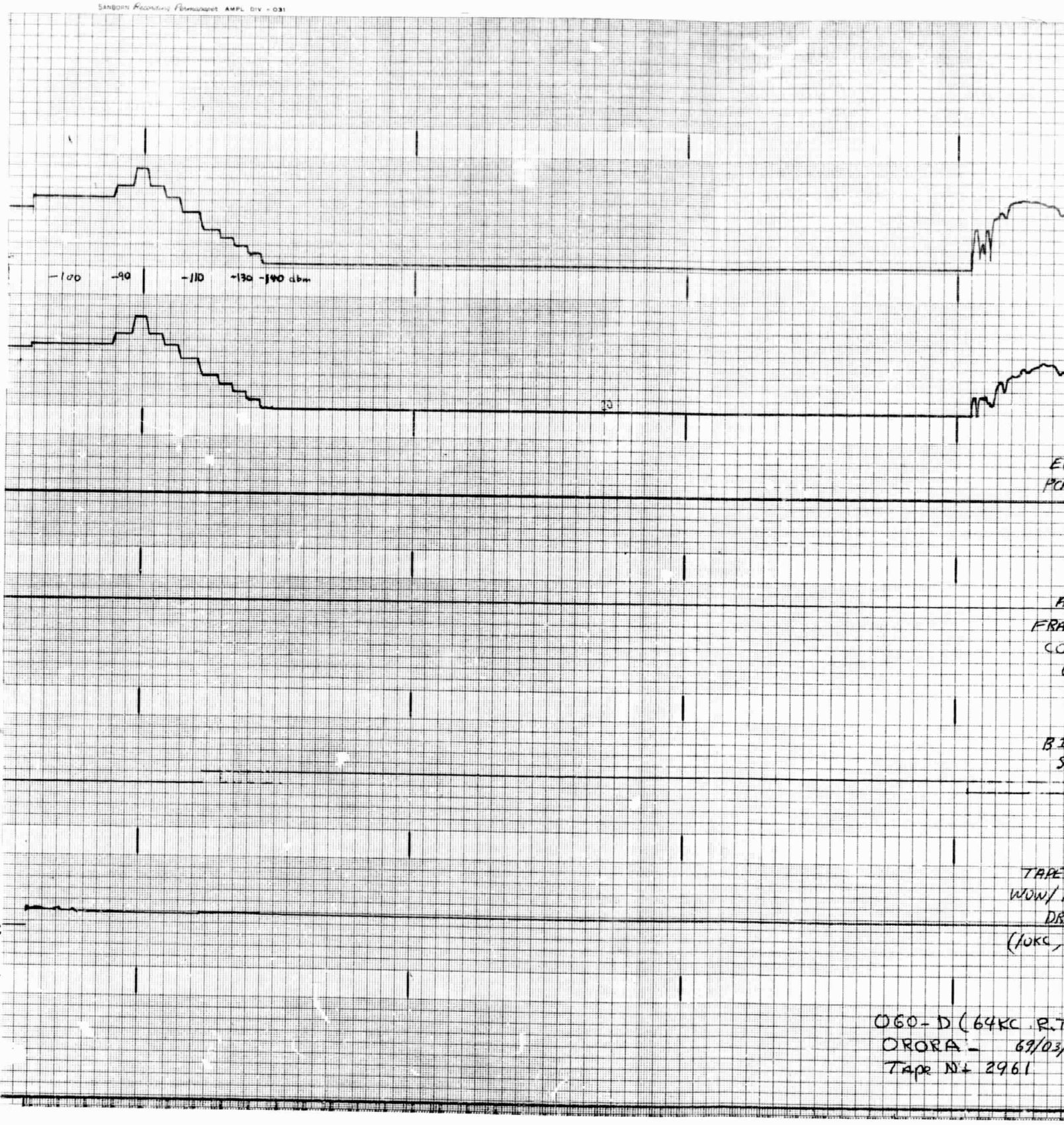


FOLDOUT FRAME

Figure A-10–IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data; ORORAL, Tape No. 2959

FOLDOUT FRAME

FOLDOUT FRAME



FOLDOUT FRAME

FOLDOU

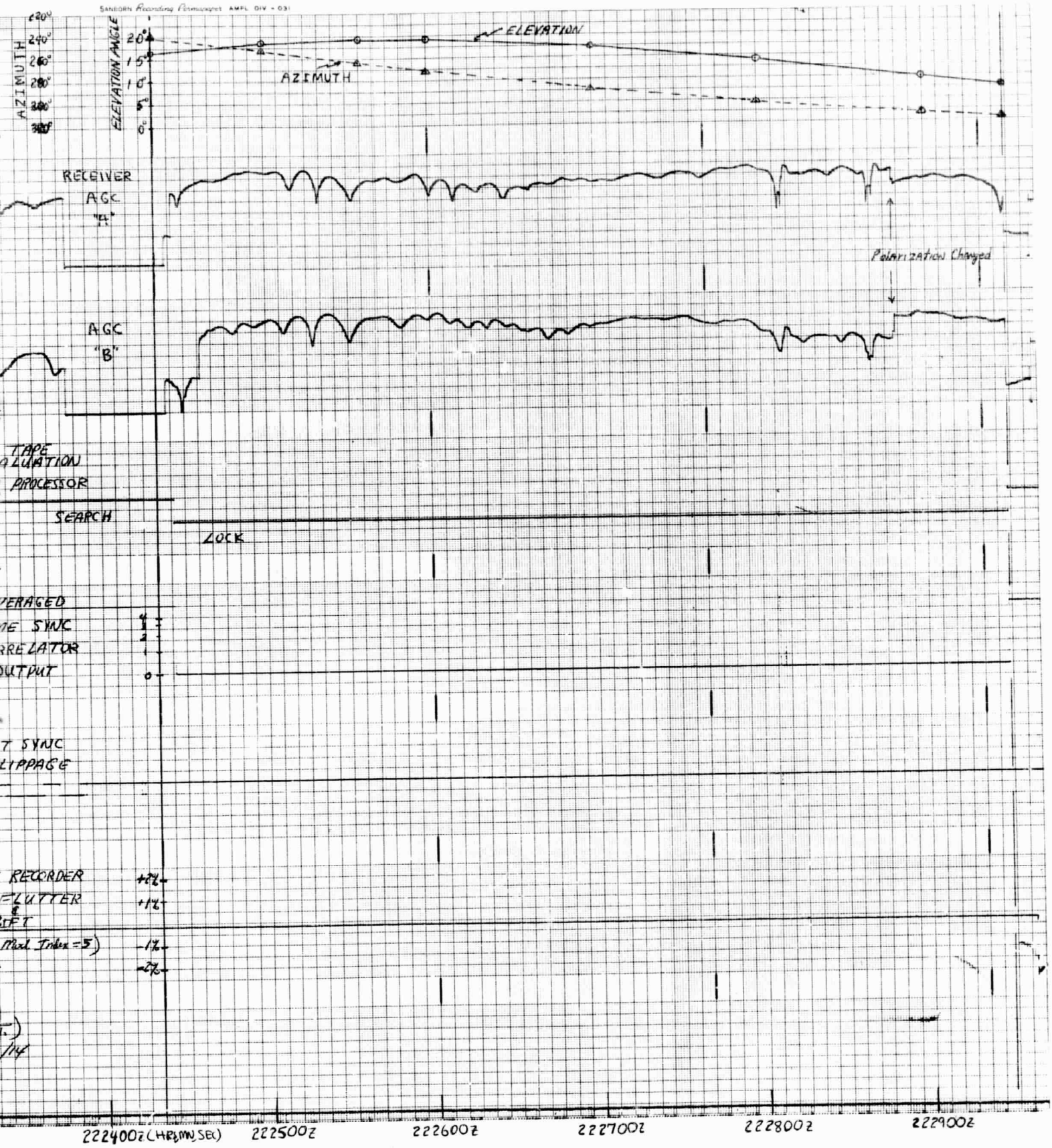
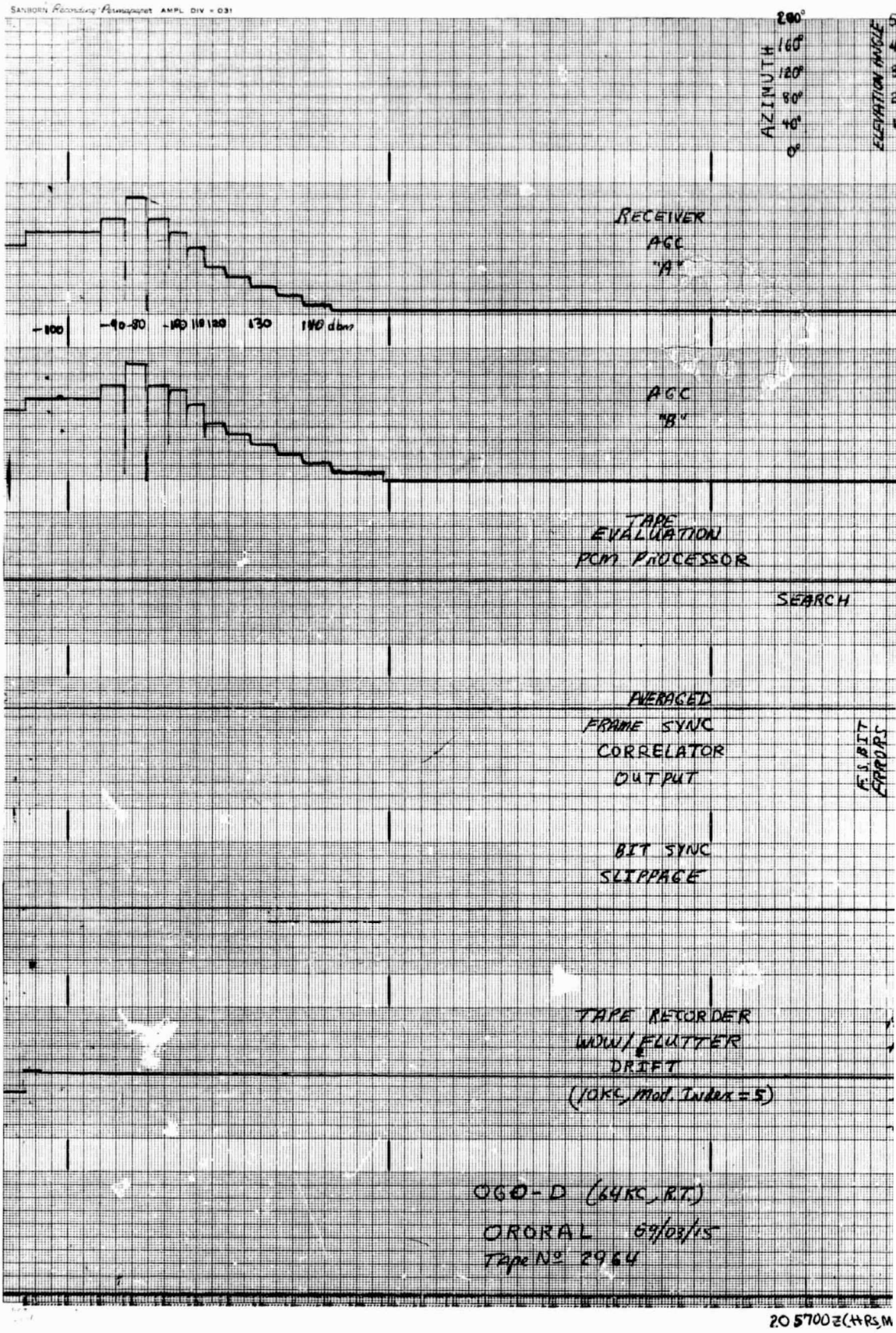


Figure A-11—IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data; ORORAL, Tape No. 2961

FOLDOUT FRAME



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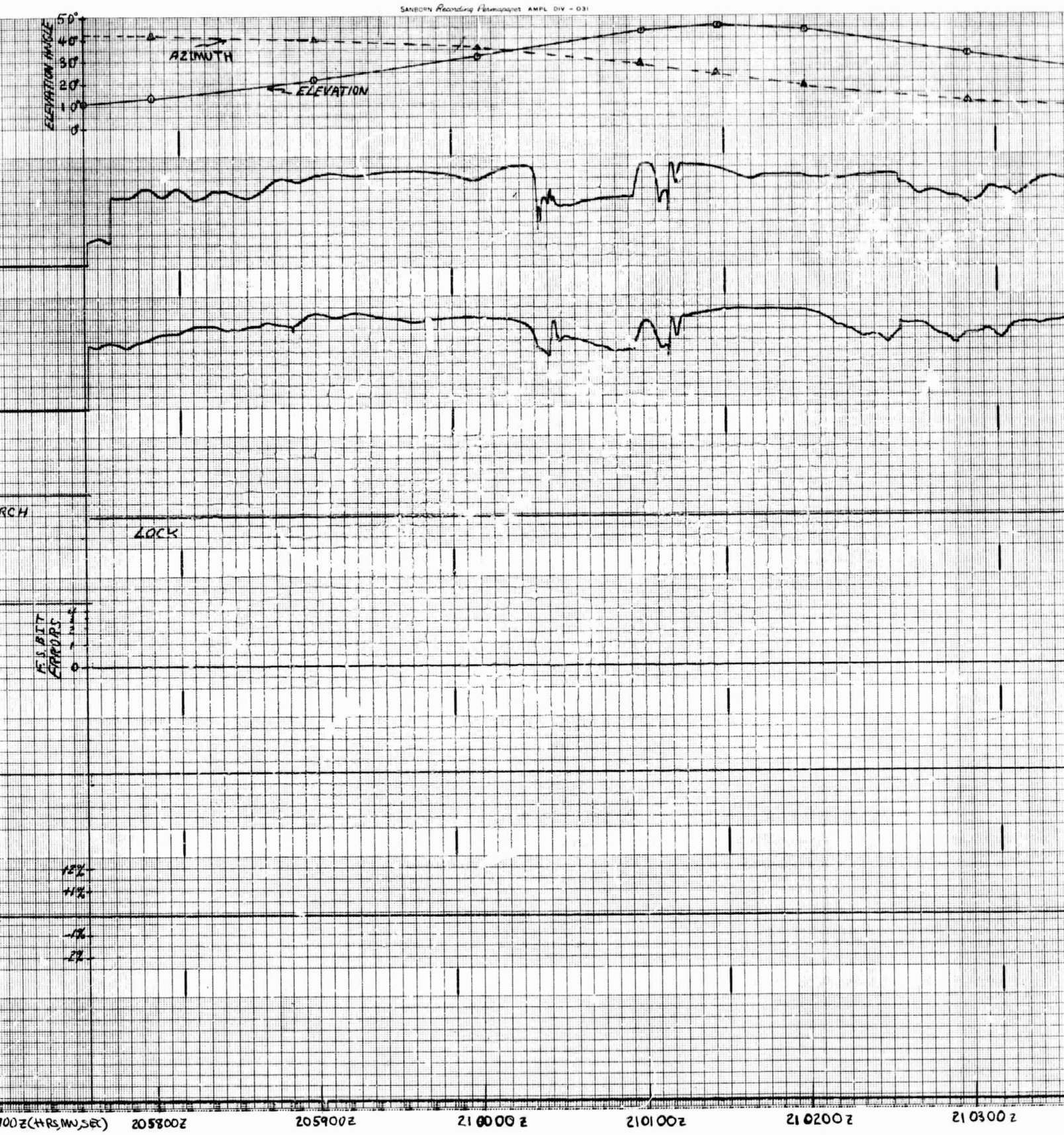
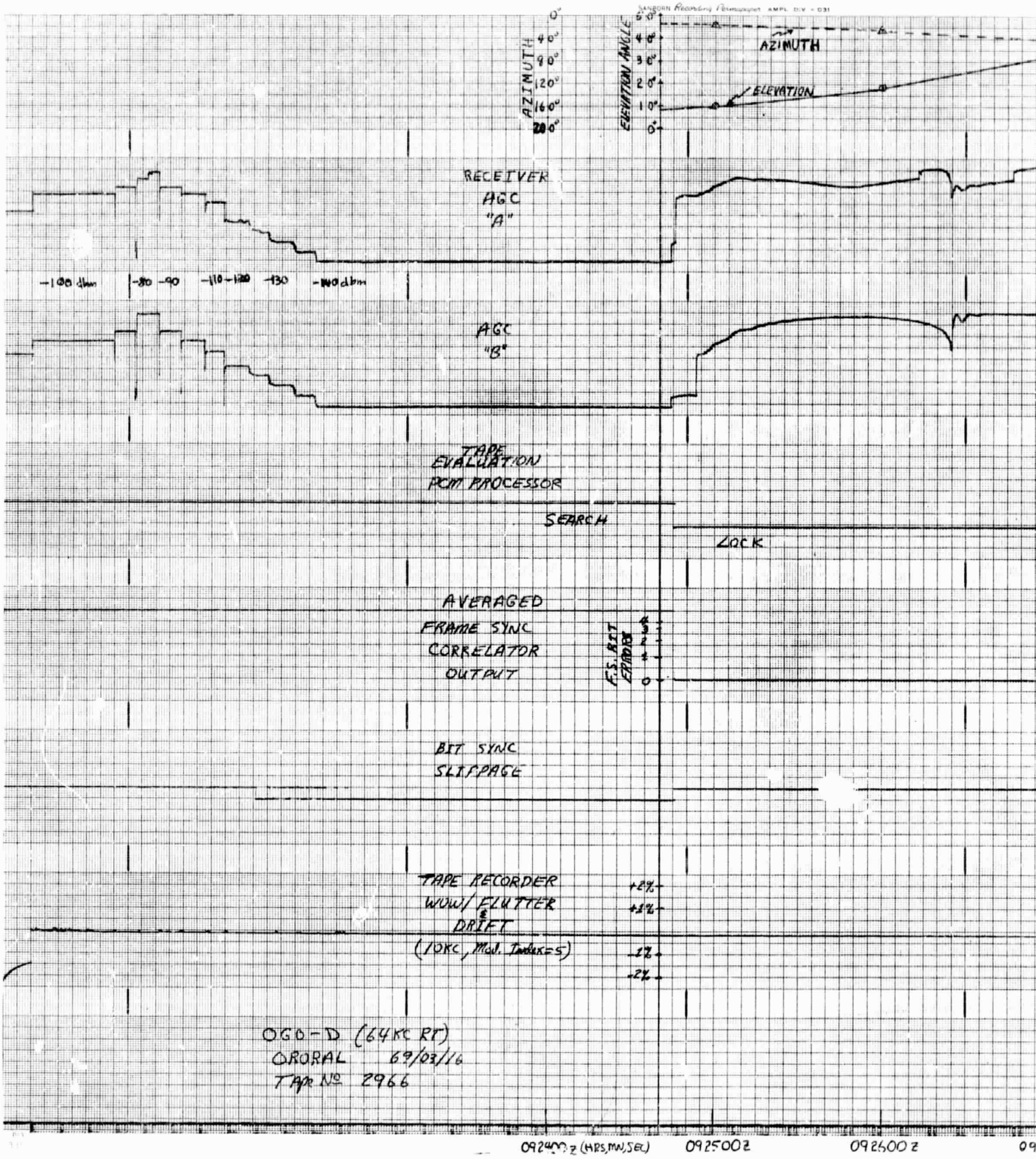


FOLDOUT FRAME 2

Figure A-12—IPD's Strip Chart A

A-12–IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data; ORORAL, Tape No. 2964

FOLDOUT FRAME 3

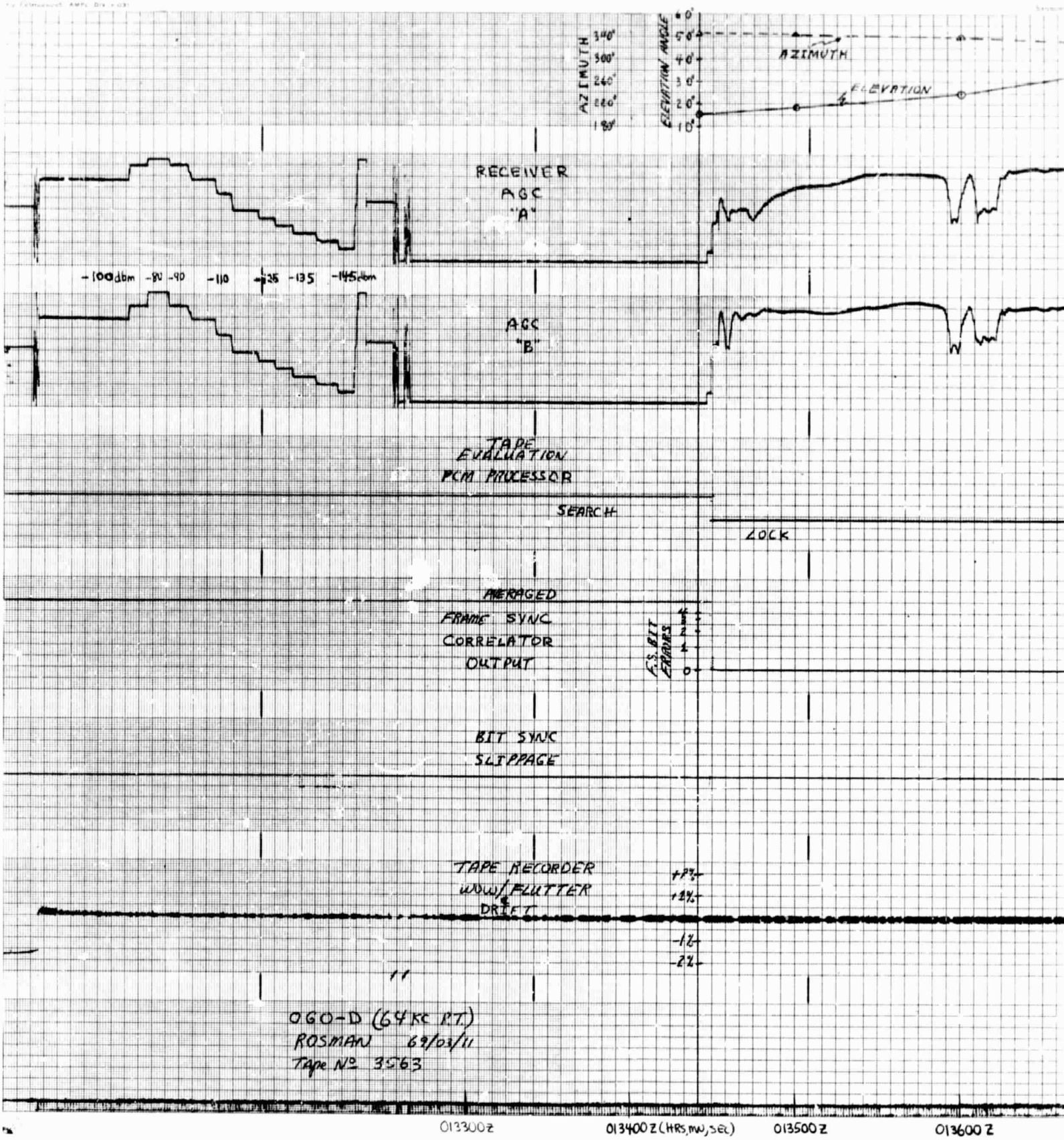


FOLDOUT FRAME

Figure A-13-IPD's Stri

Figure A-13–IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data: ORORAL, Tape No. 2966

FOLDOUT FRAME

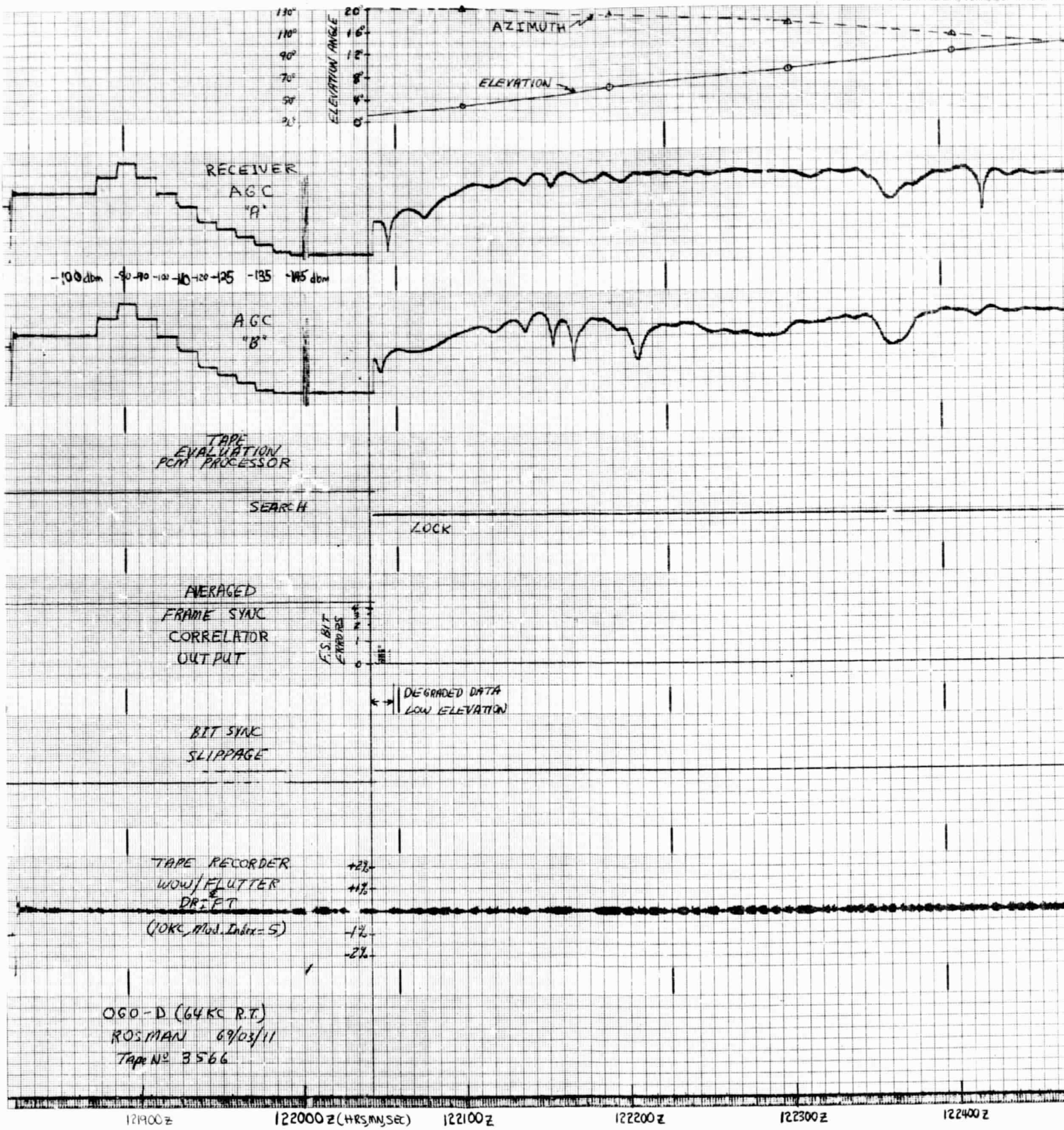


FOLDOUT FRAME

Figure A-14–IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data; ROSMAN, Tape No. 3563

FOLDOUT FRAME

FOLDOUT FRAME



FOLDOUT FRAME 52

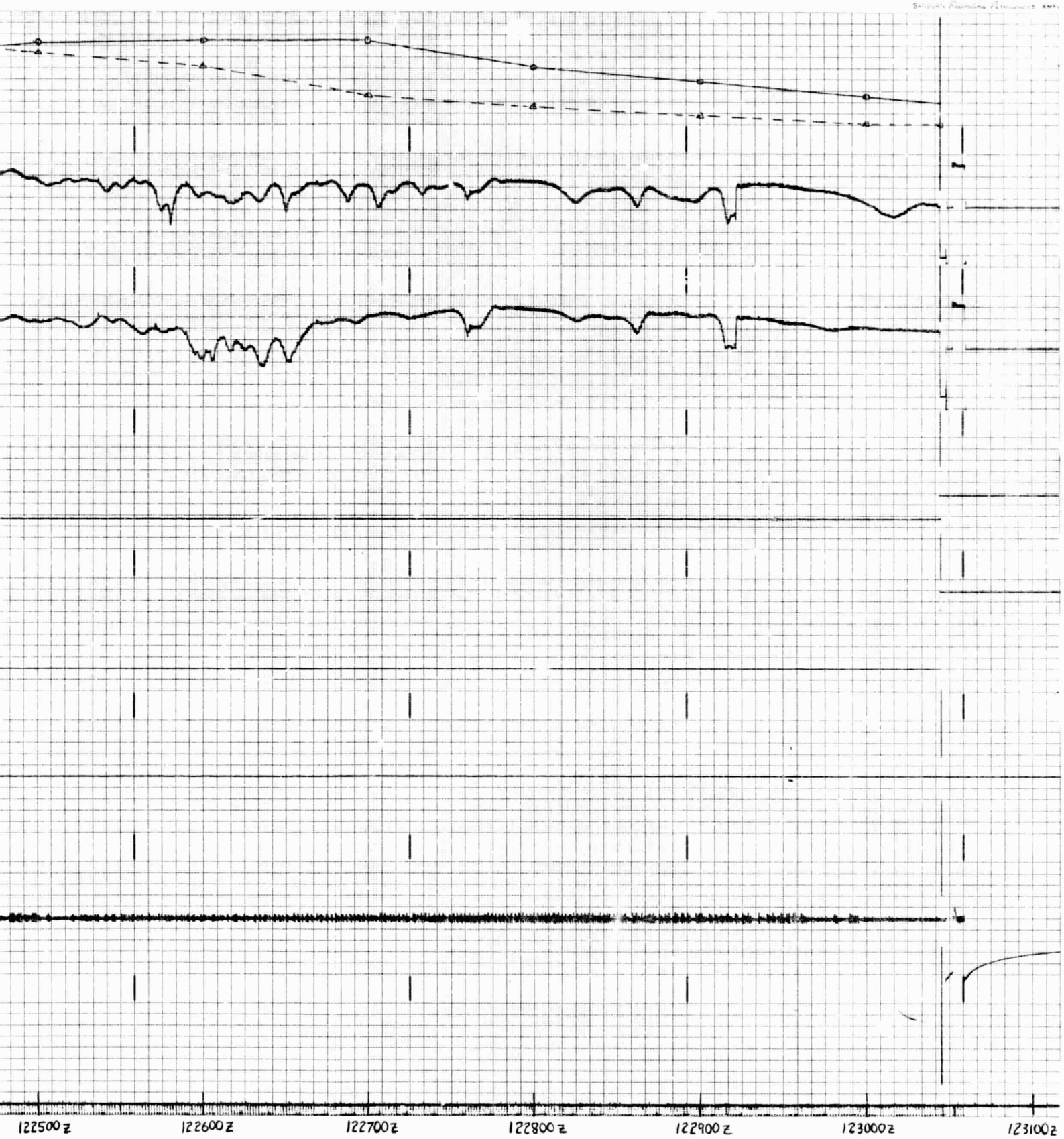
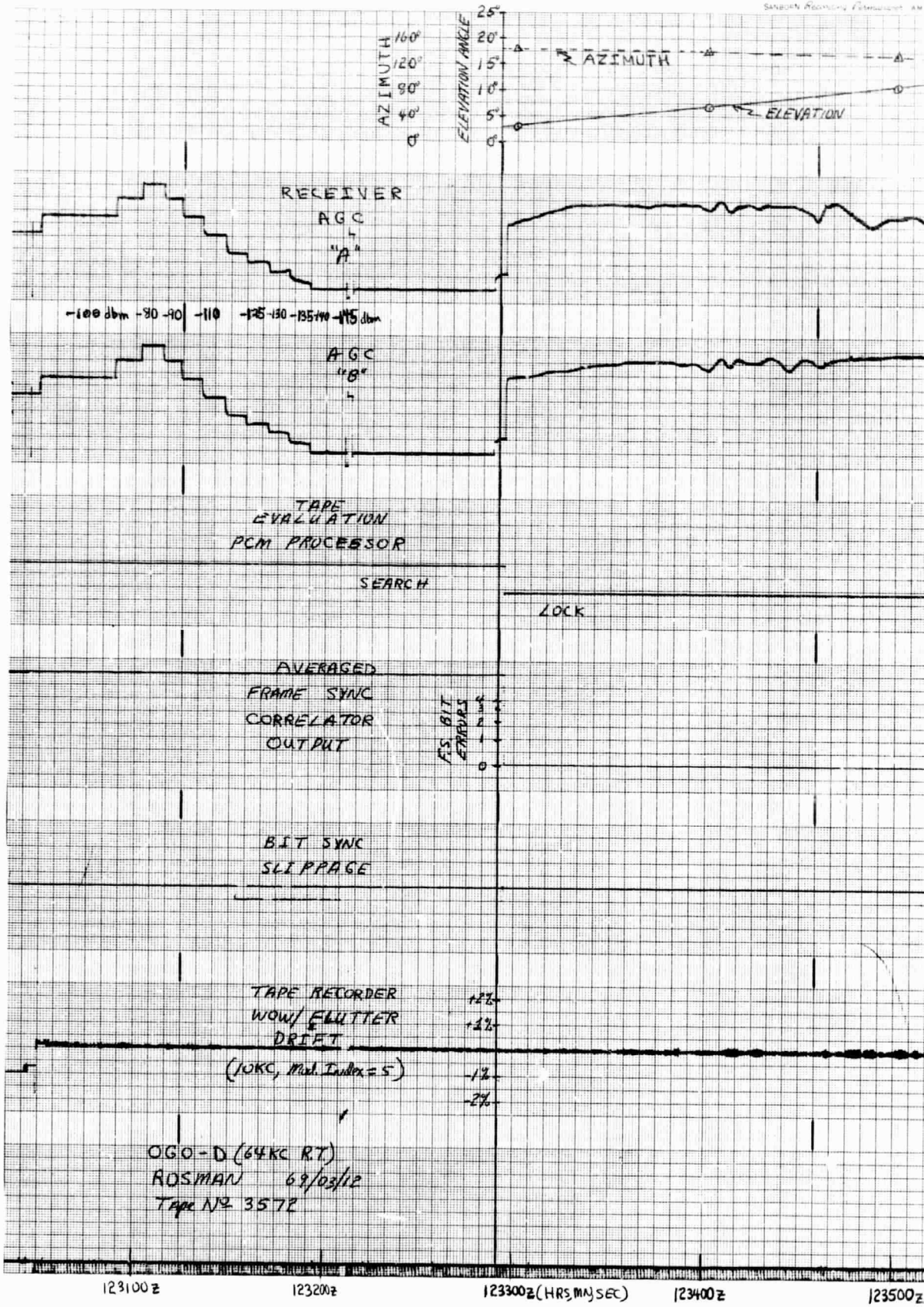


Figure A-15–IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data; ROSMAN, Tape No. 3566

DOUT FRAME

FOLDOUT FRAME



FOLDOUT FRAME 1

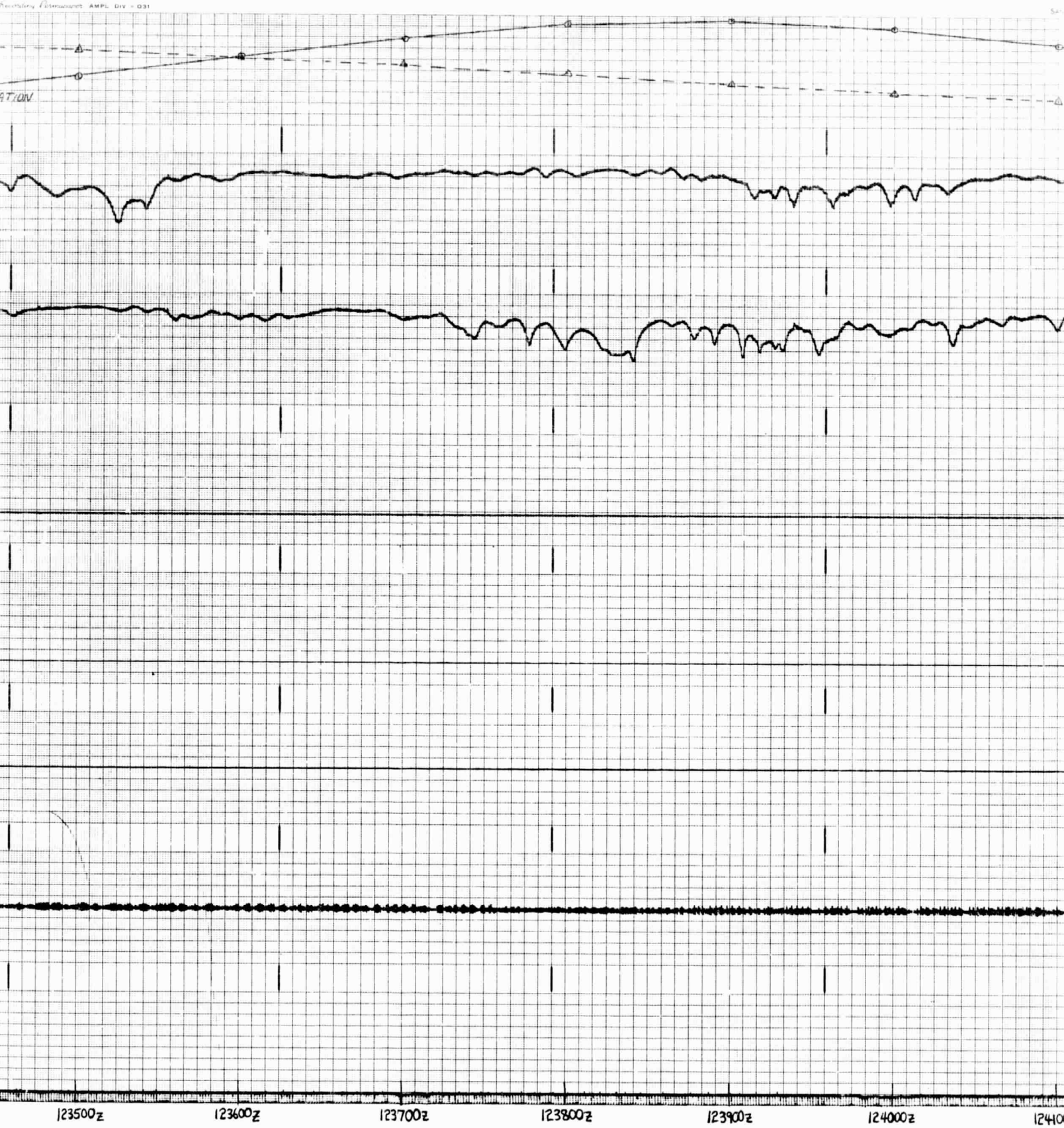
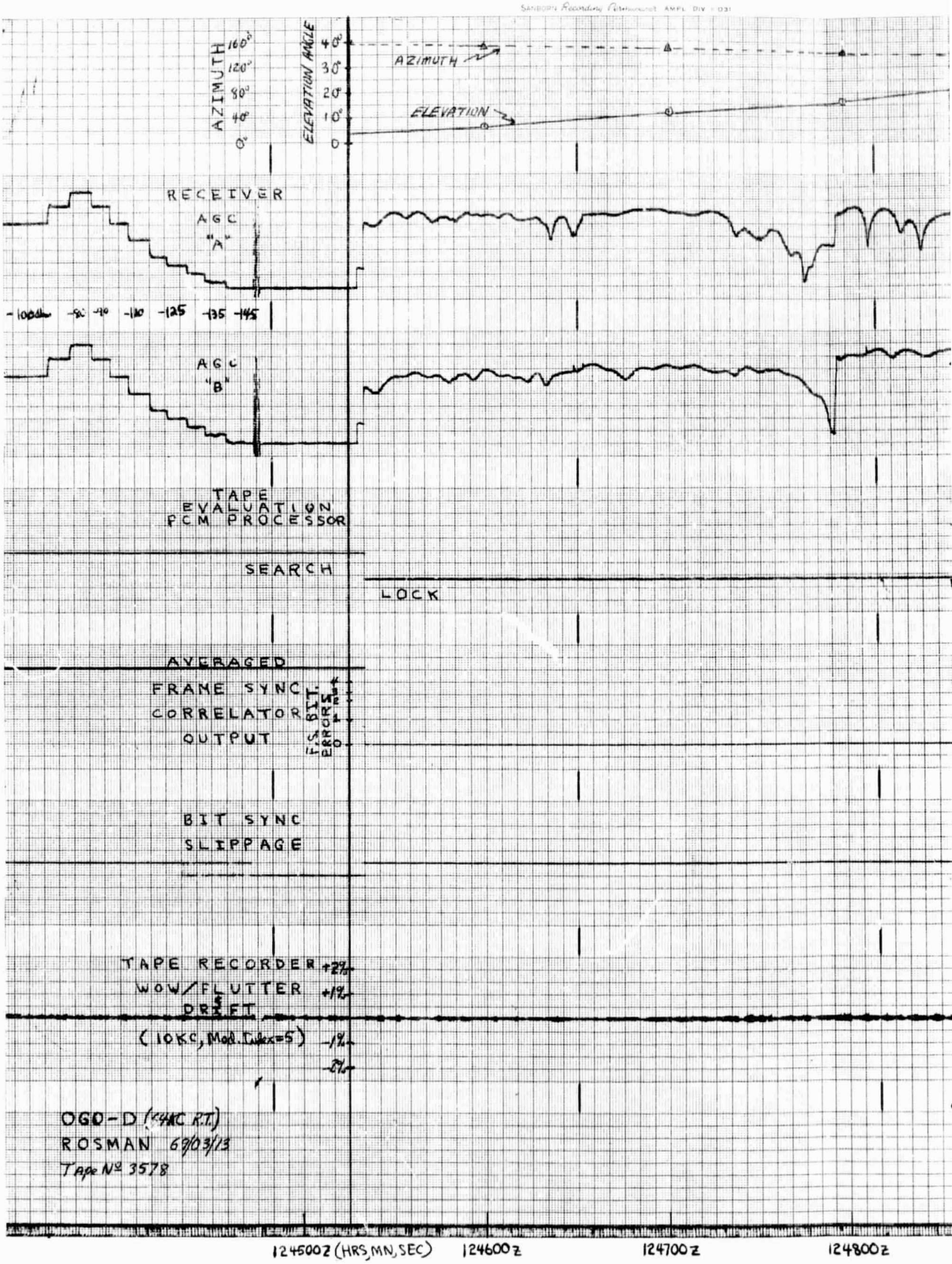


Figure A-16–IPD's Strip Chart Analy

FRAME 2

ip Chart Analysis of OGO-D 64 KC R.T. Data; ROSMAN, Tape No. 3572

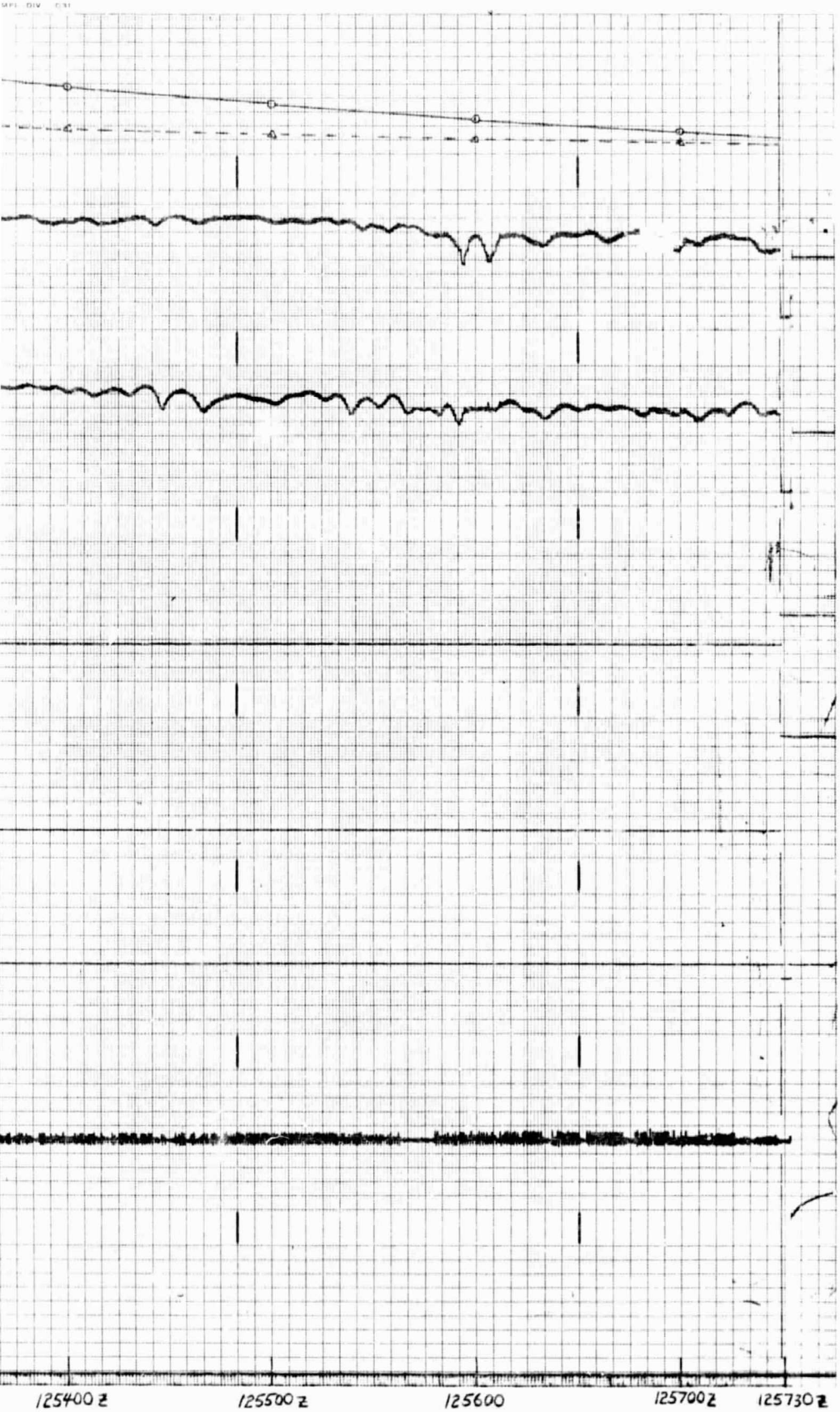
FOLDOUT FRAME 5


AZIMUTH
160°
120°
80°
40°
0°
ELEVATION ANGLE
40°
30°
20°
10°
0
AZIMUTH
ELEVATION
RECEIVER AGC "A"
-100db -80 -90 -120 -125 -135 -145
AGC "B"
TAPE EVALUATION PCM PROCESSOR
SEARCH
LOCK
AVERAGED FRAME SYNC CORRELATOR OUTPUT
F.S. BIT ERRORS
BIT SYNC SLIPPAGE
TAPE RECORDER WOW/FLUTTER DRIFT
(10KC, Mod. Index=5)
+2%
+1%
-1%
-2%
OGO-D (KMC R.T.)
ROSMAN 69/03/13
Tape Nº 3578
1245002 (HRS, MN, SEC)
124600z
124700z
124800z

56

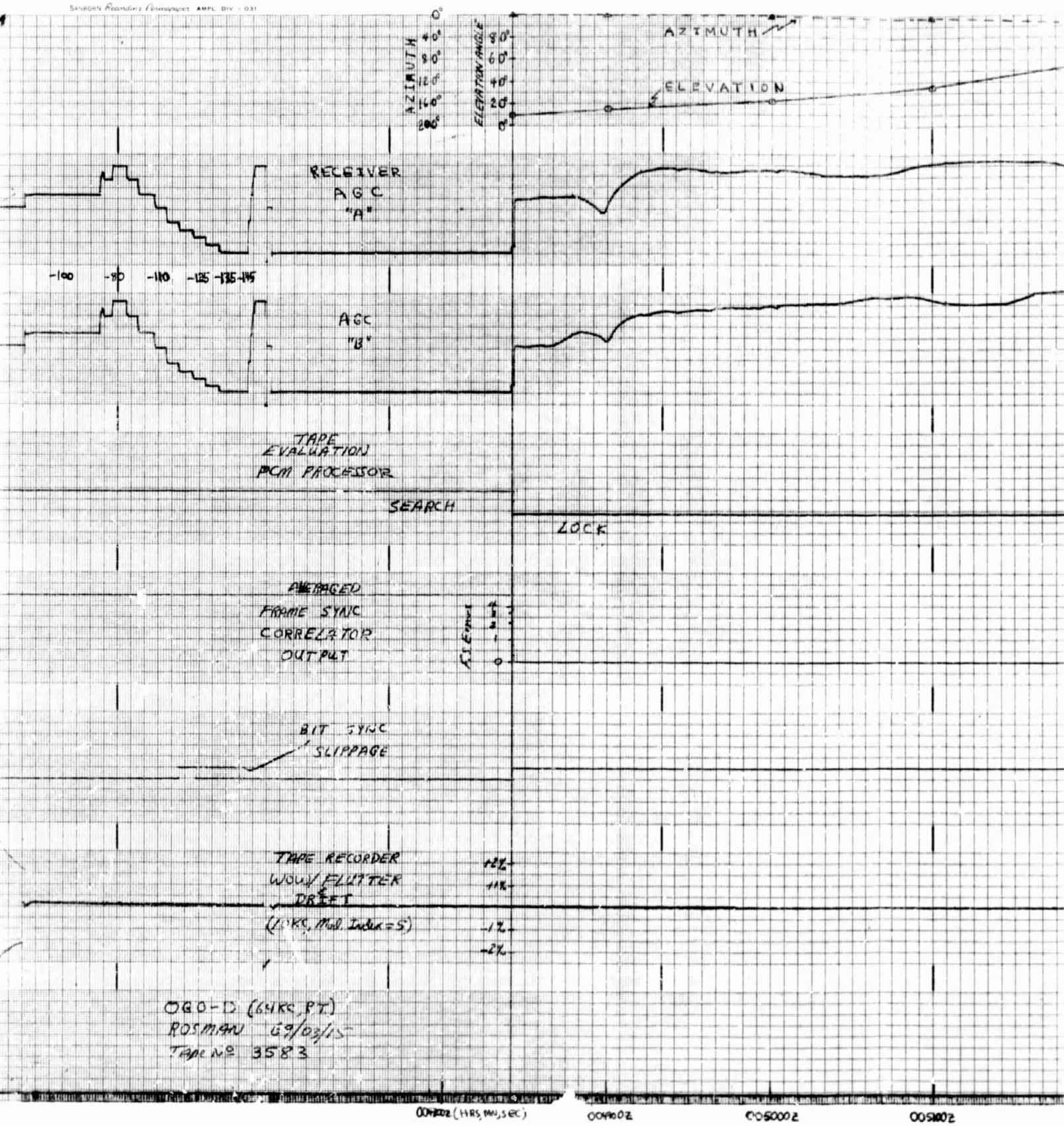
FOLDOUT FRAME 2

Figure A-17—IPD's Strip Chart Ana



trip Chart Analysis of OGO-D 64 KC R.T. Data; ROSMAN, Tape No. 3578

FOLDOUT FRAME 3



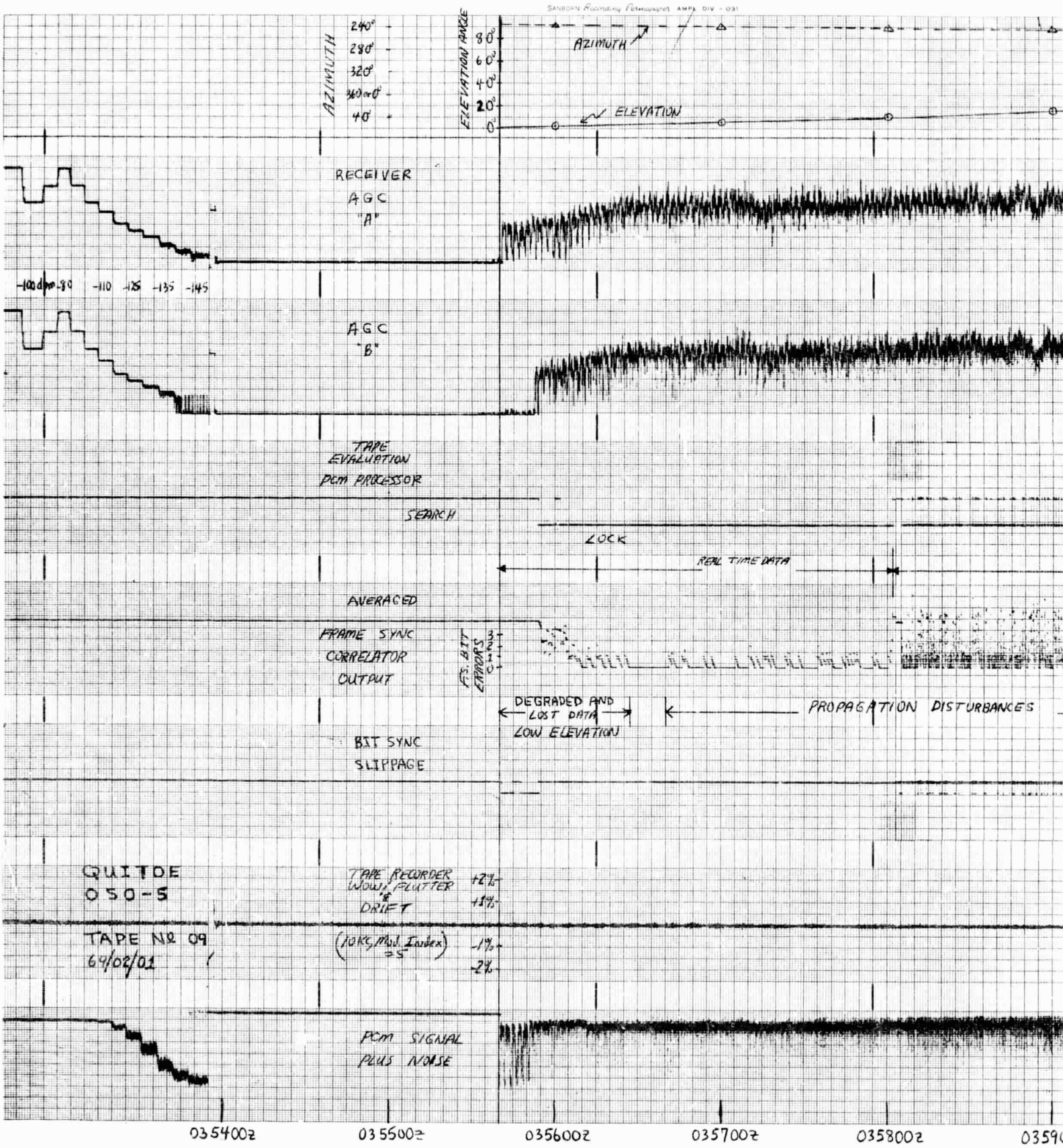
FOLDOUT FRAME

Figure A-18—IPD's Strip Chart Analysis of OGO-D 64 KC R.T. Data; ROSMAN, Tape No. 3583

FOLDOUT FRAME

APPENDIX B

Tape Evaluation Strip Charts for OSO-F



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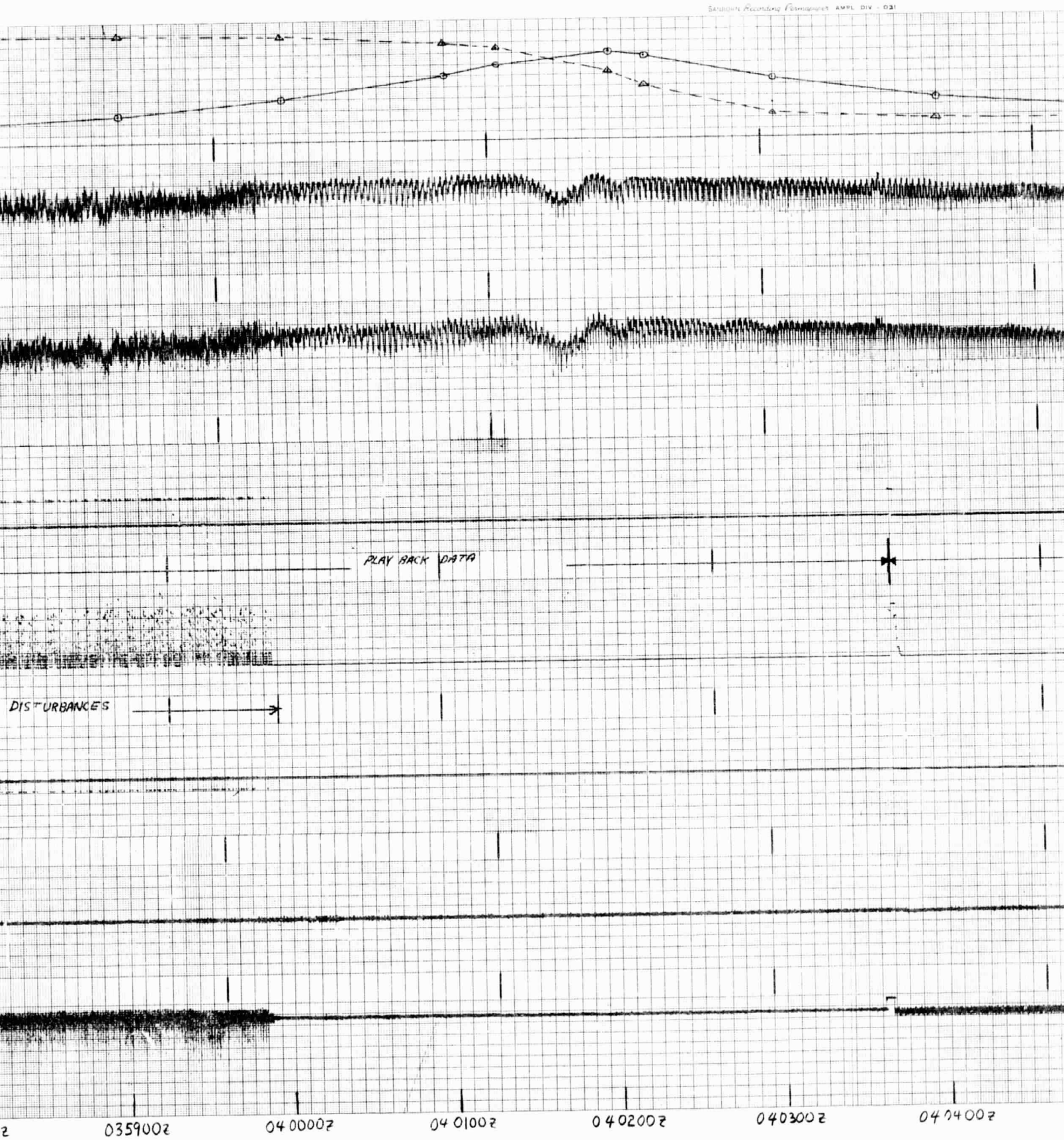


Figure B-1

FOLDOUT FRAME 2

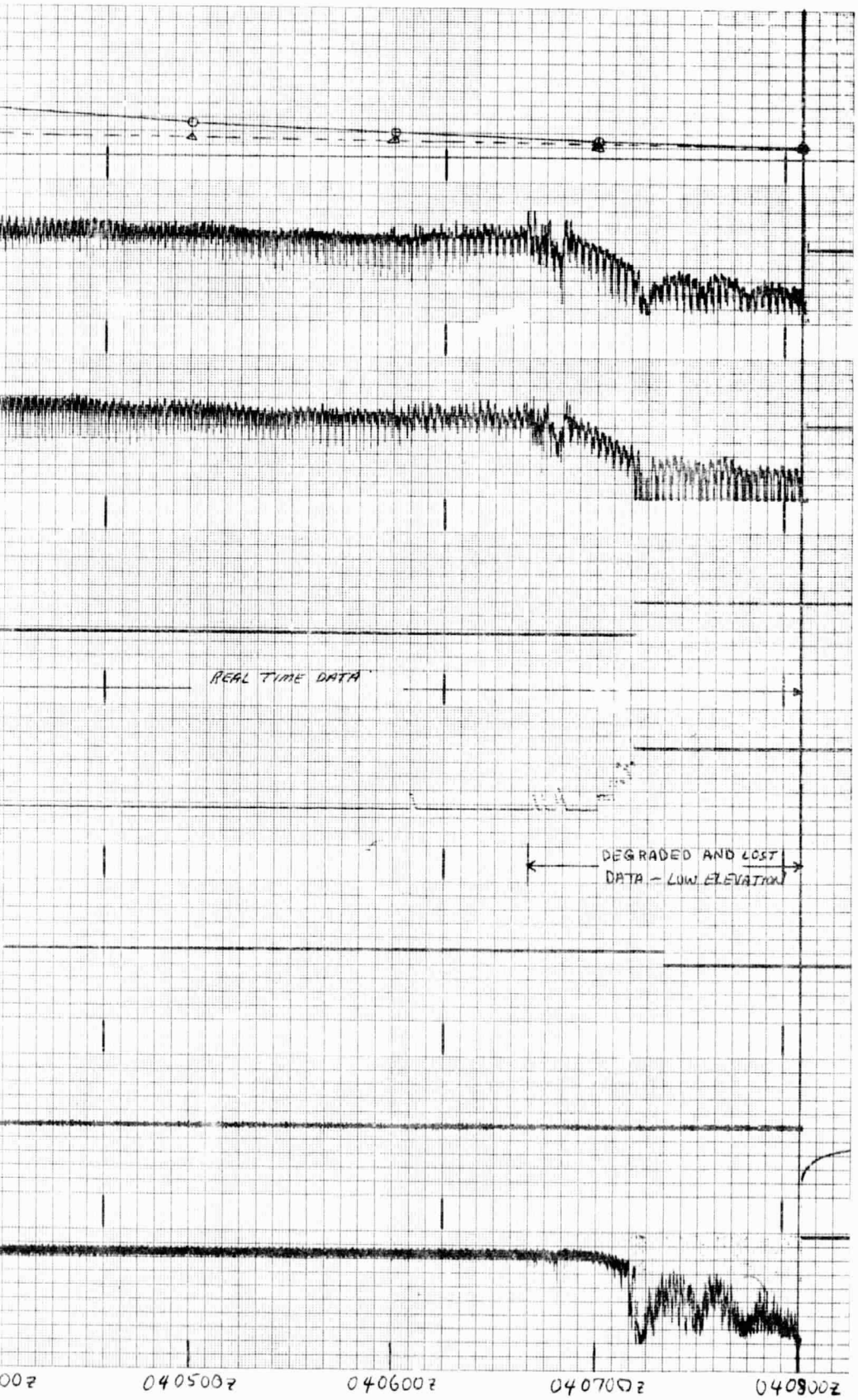
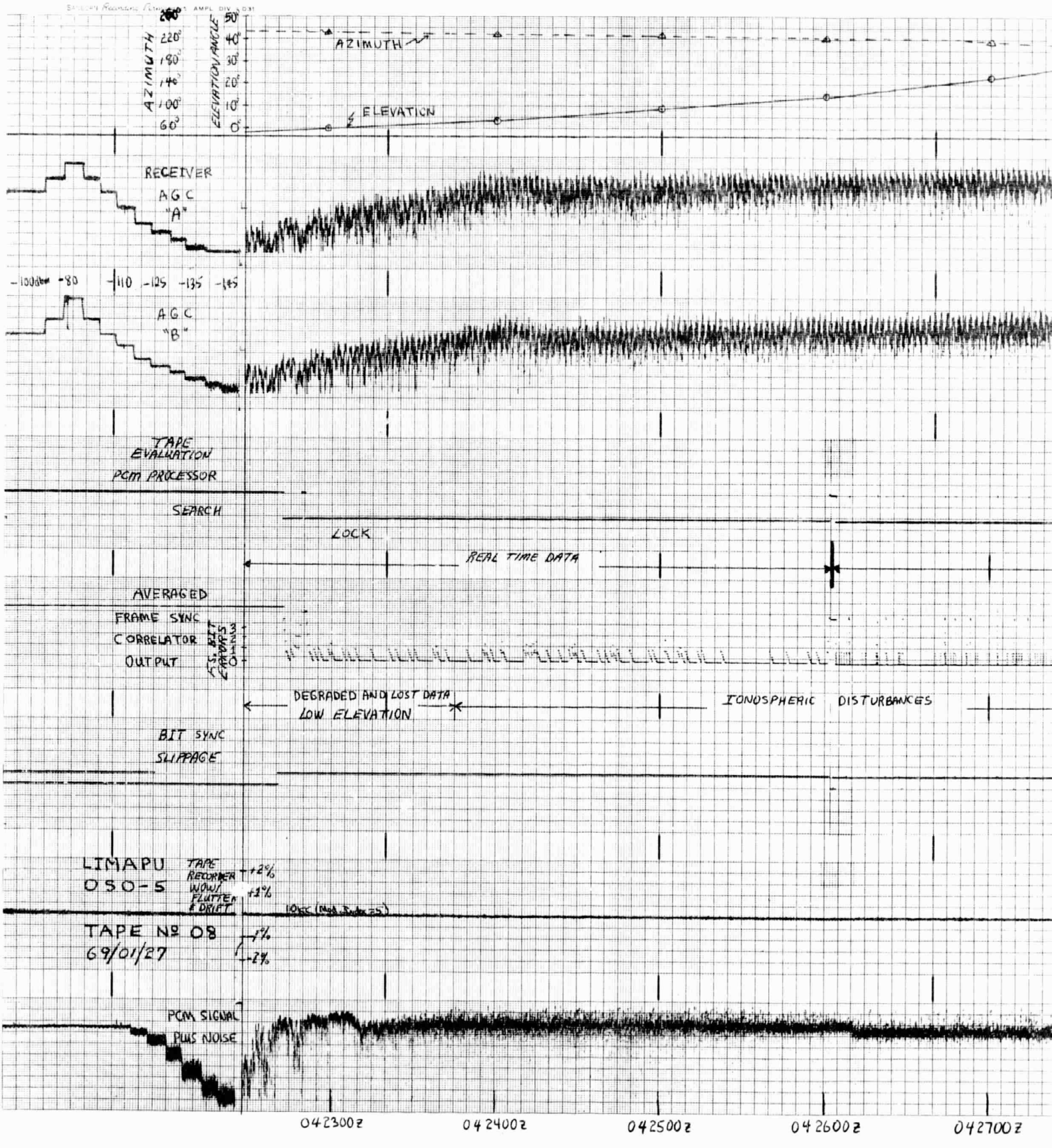
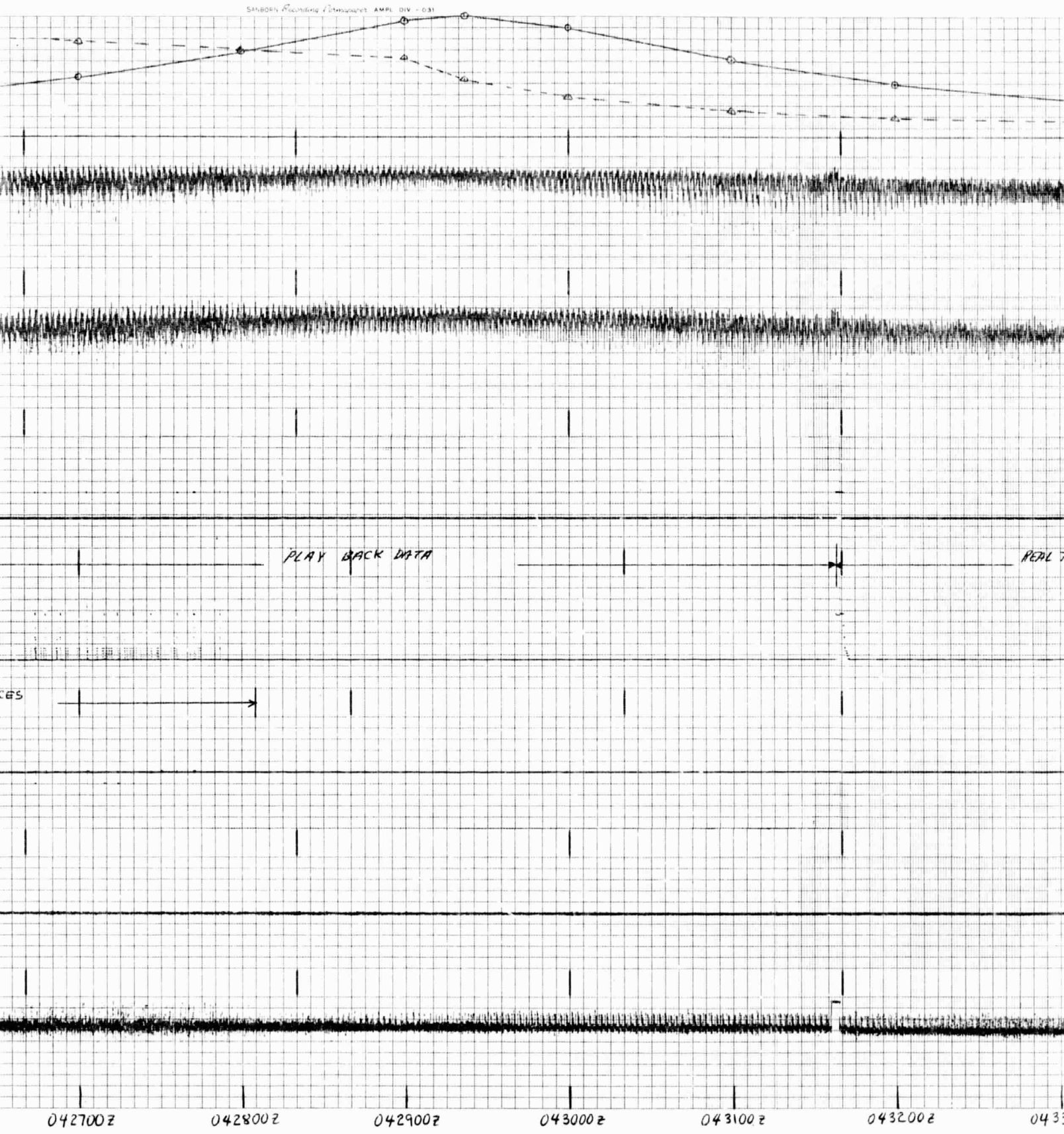


Figure B-1–IPD's Strip Chart Analysis of OSO-F Data; QUITOE, Tape No. 9

FOLDOUT FRAME 3

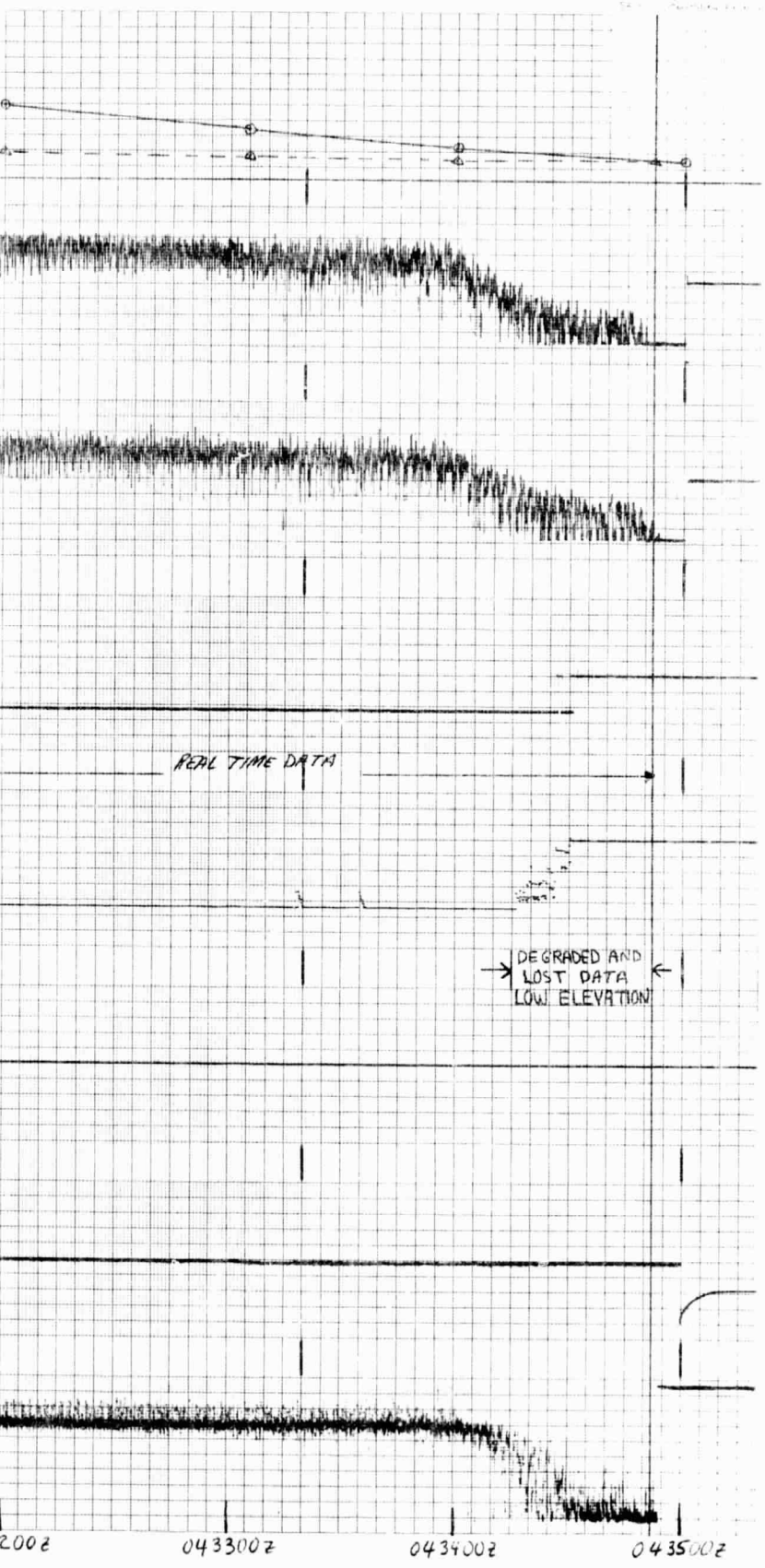


FOLDOUT FRAME 1



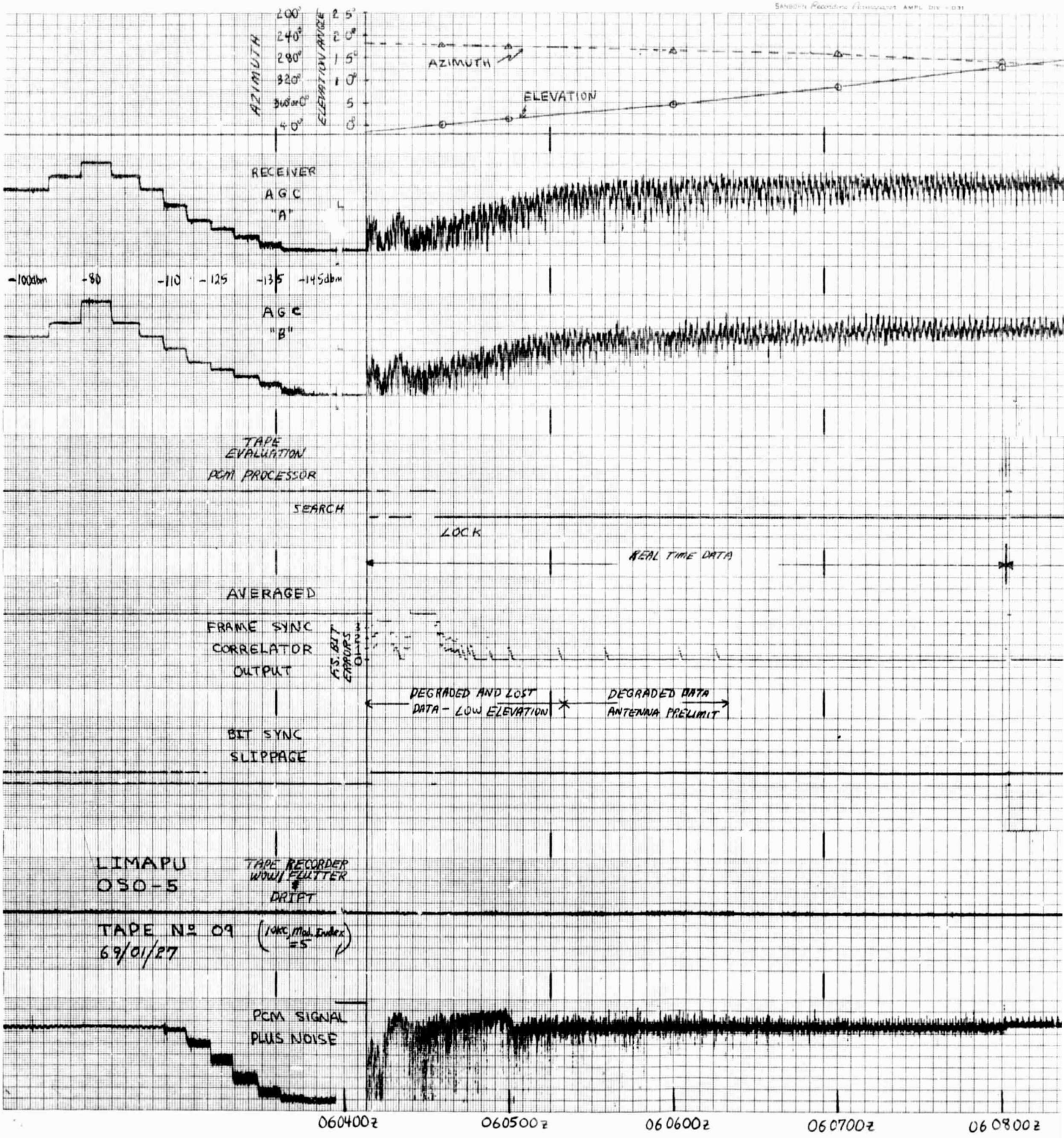
FOLDOUT FRAME 2

Figure B-2—IPD's Strip Chart A

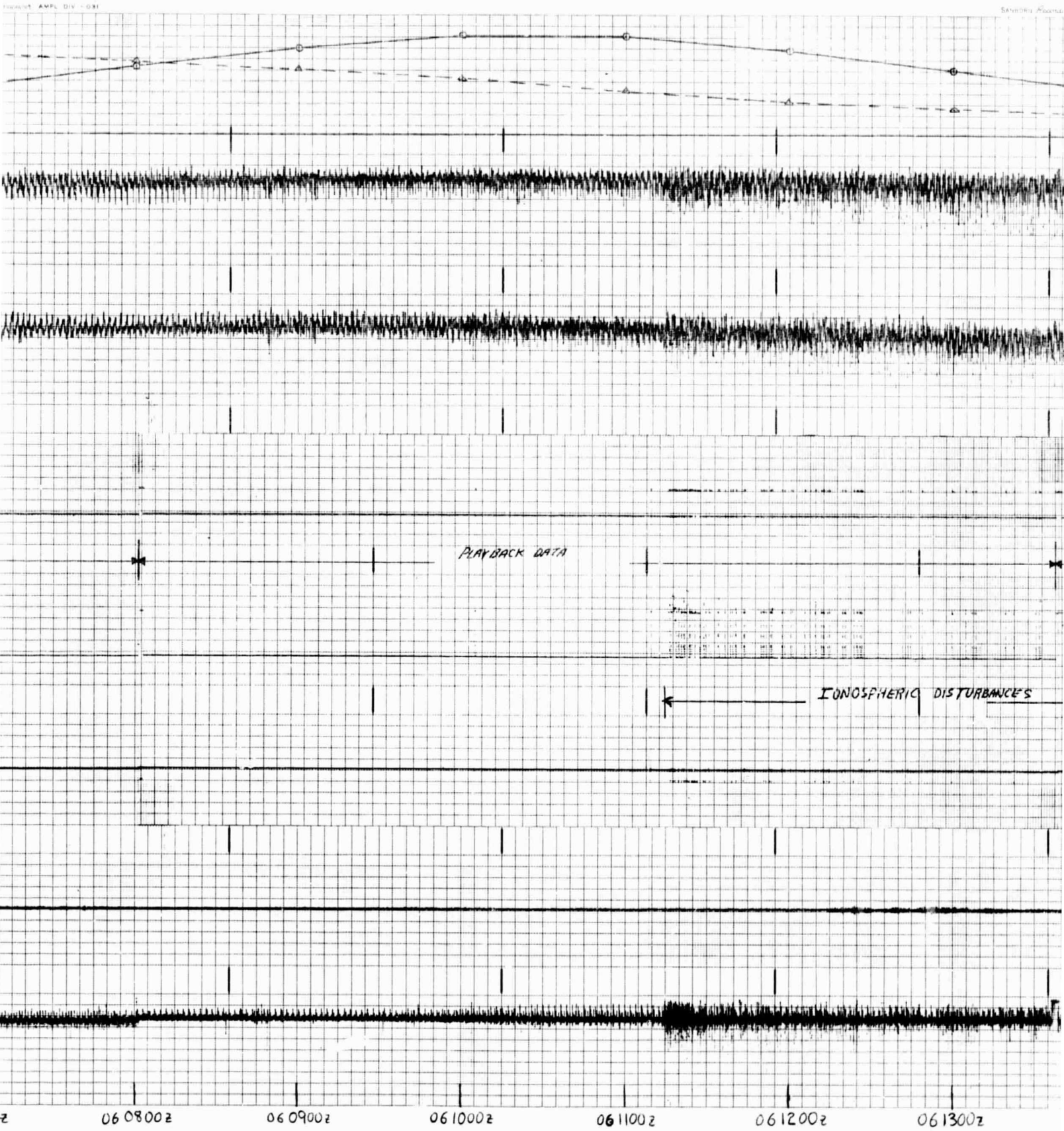


-IPD's Strip Chart Analysis of OSO-F Data; LIMA, Tape No. 8

FOLDOUT FRAME 3



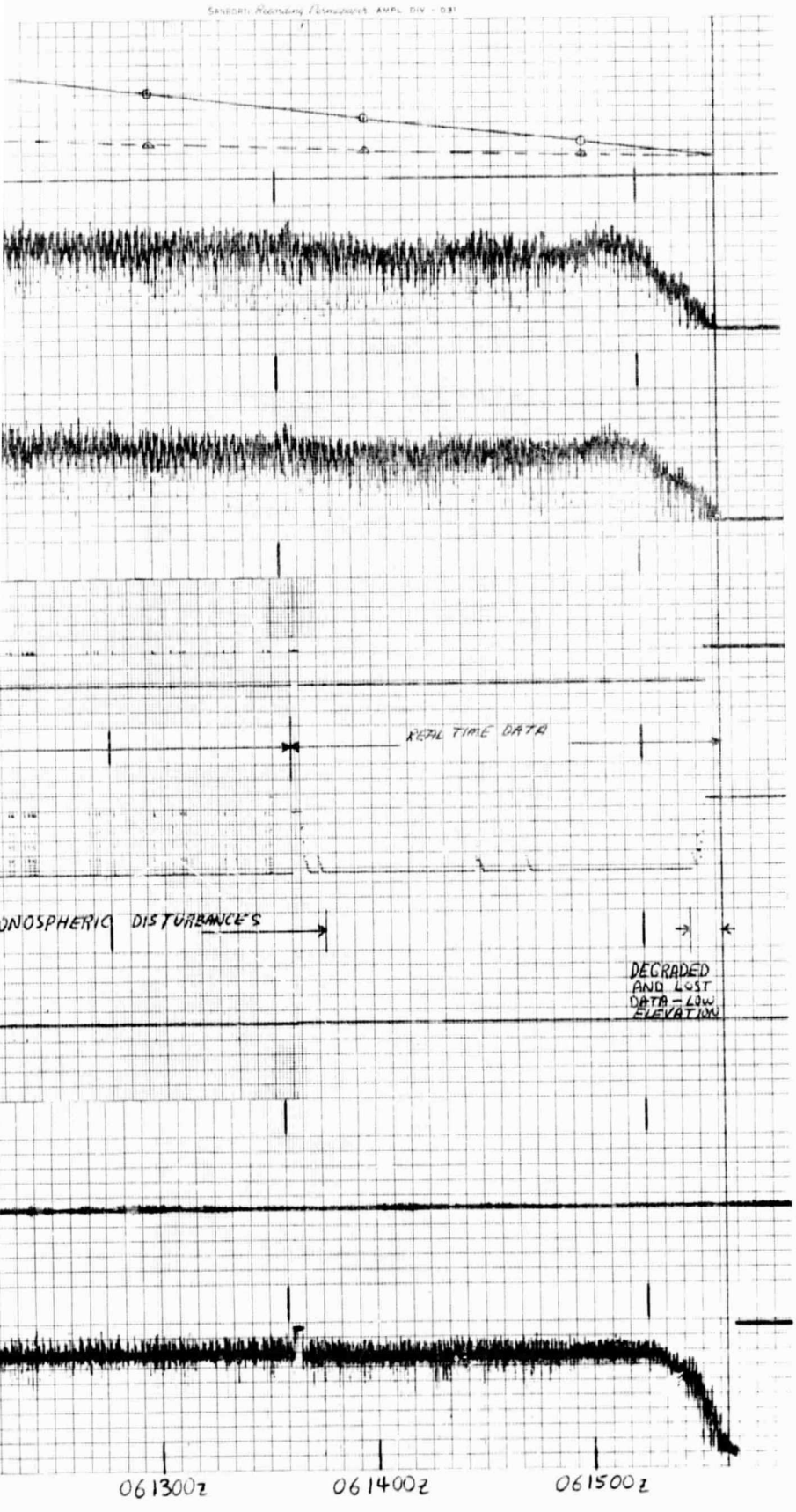
FOLDOUT FRAME 1



FOLDOUT FRAME 2

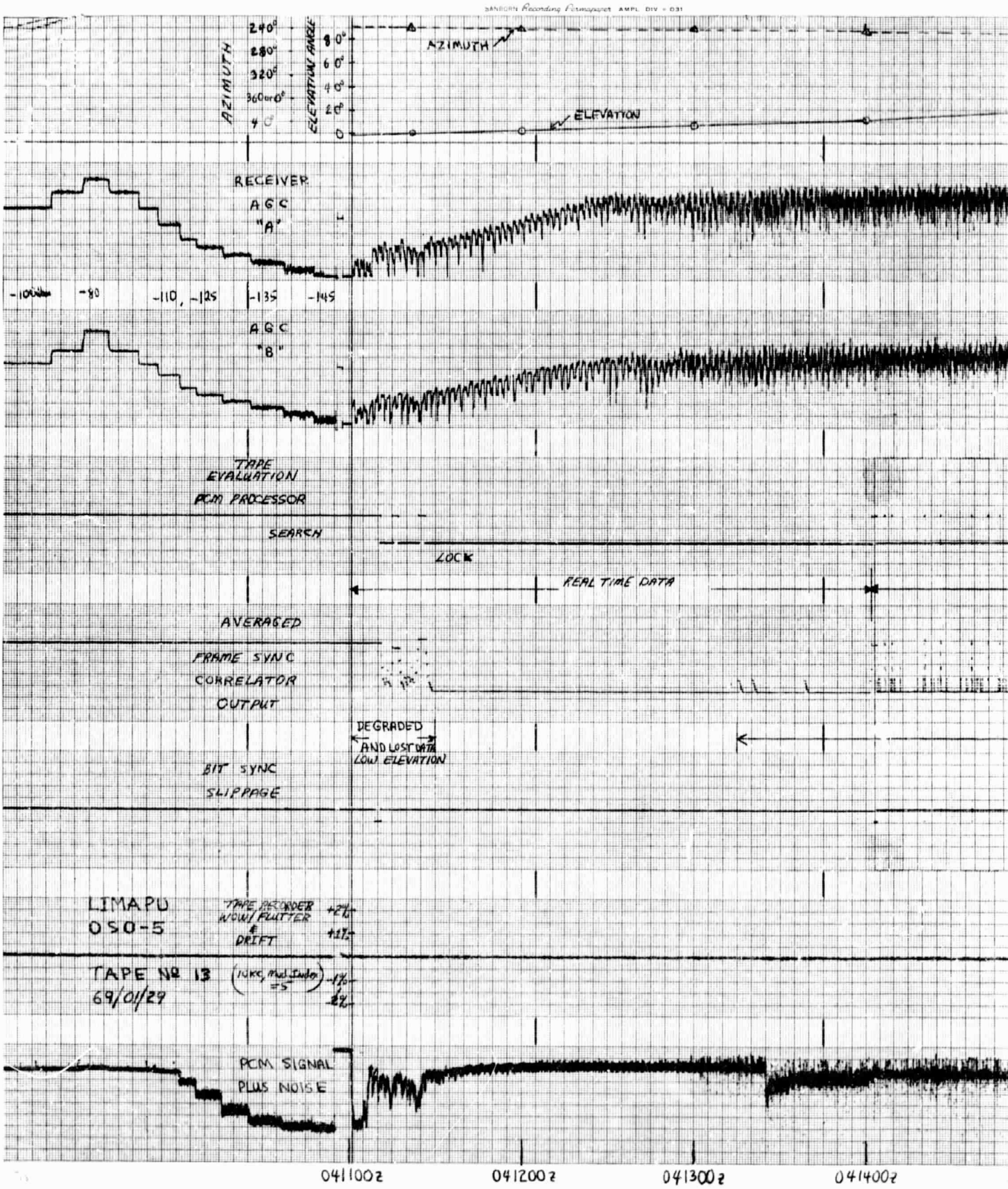
Figure B-3—IPD's Strip Chart Anal

FOLDOU

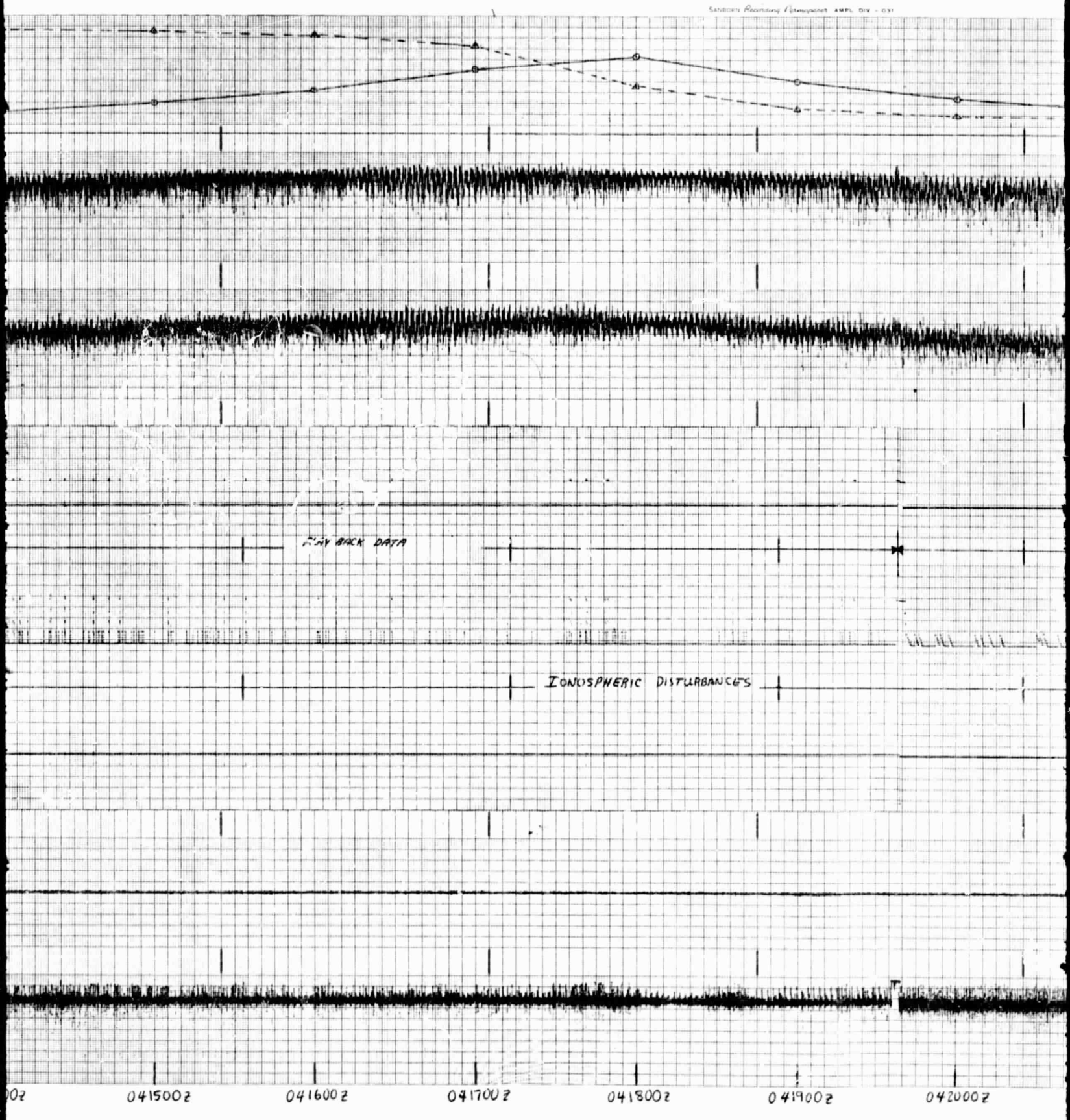


B-3–IPD's Strip Chart Analysis of OSO-F Data; LIMA, Tape No. 9

FOLDOUT FRAME 3



FOLDOUT FRAME 1



FOLDOUT FRAME 2

Figure B-4-IPD's

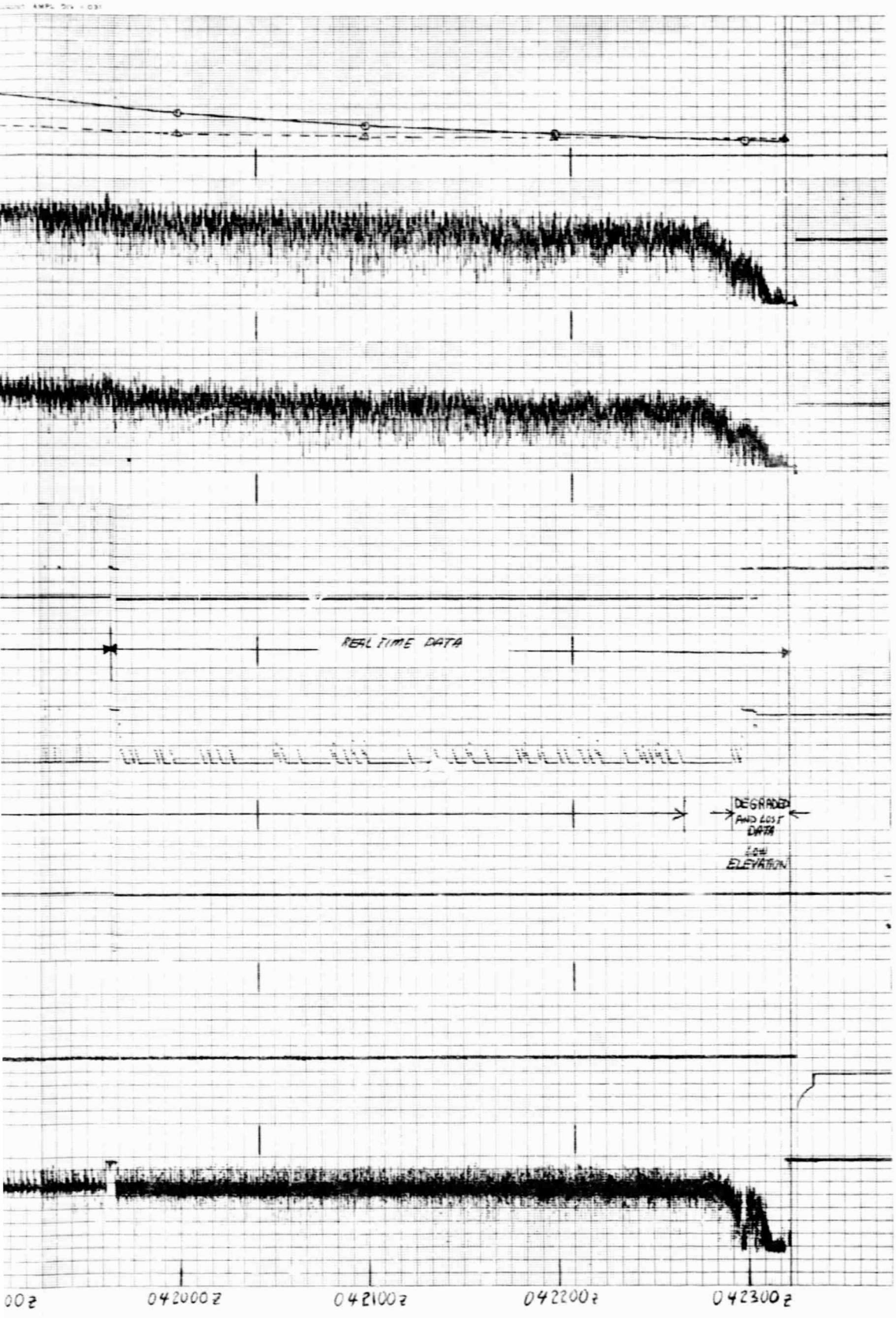
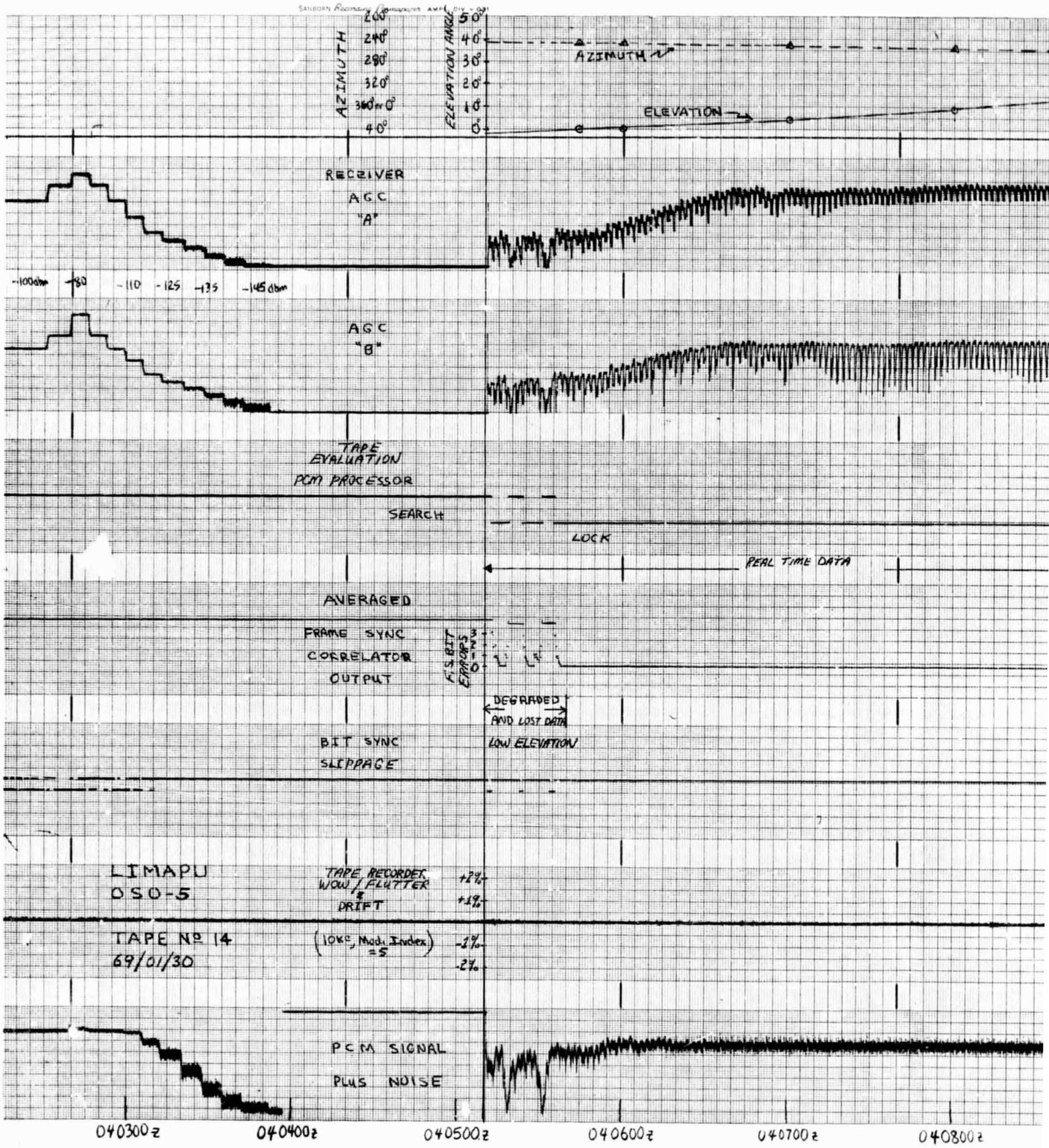


Figure B-4—IPD's Strip Chart Analysis of OSO-F Data; LIMA, Tape No. 13

FOLDOUT FRAME 3



FOLDOUT FRAME 1

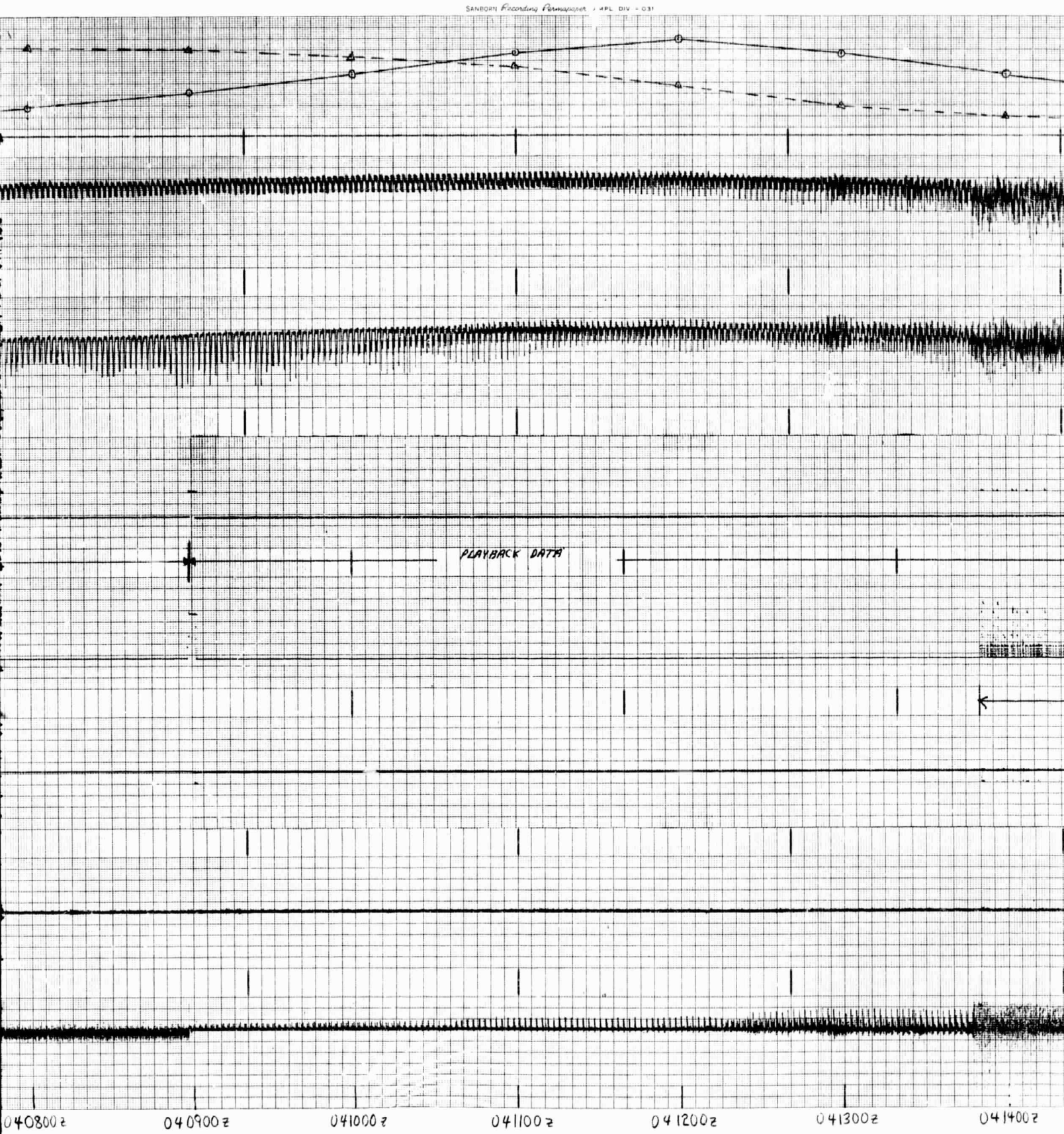


Figure B-5-

FOLDOUT FRAME 2

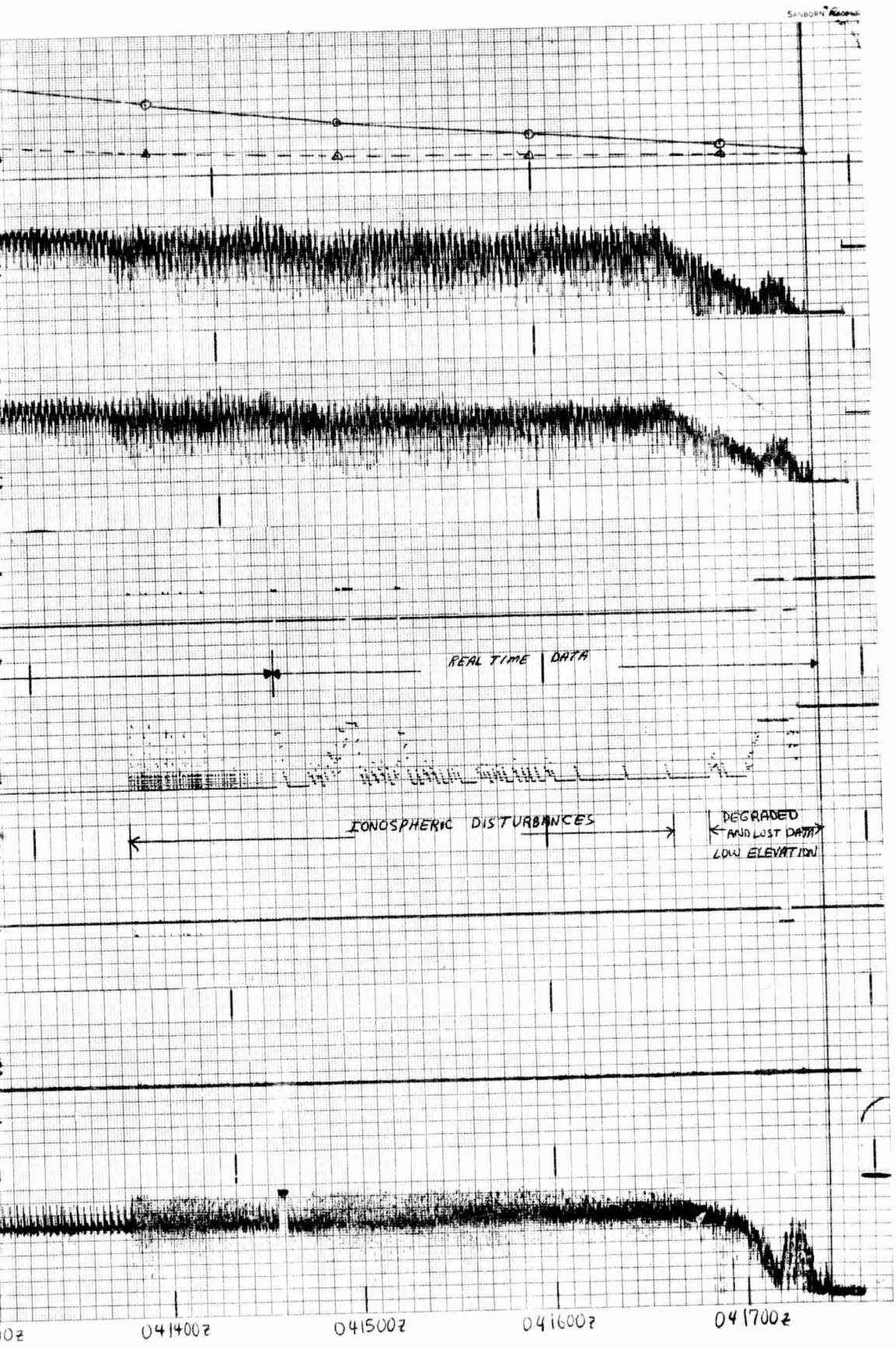
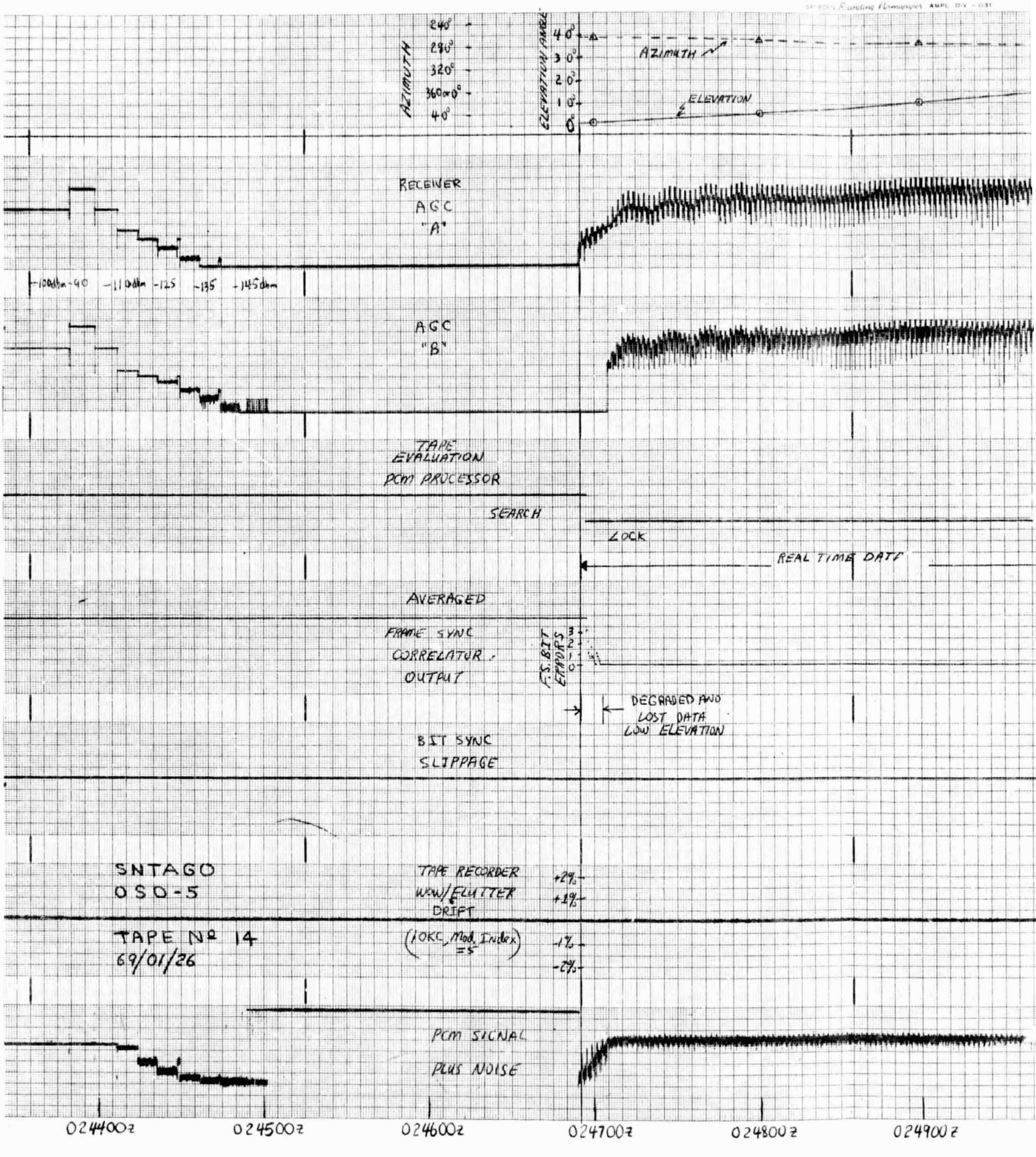


Figure B-5—IPD's Strip Chart Analysis of OSO-F Data; LIMA, Tape No. 14

FOLDOUT FRAME 3


AZIMUTH
240°
280°
320°
360≡0°
40°
ELEVATION ANGLE
40°
30°
20°
10°
0°
AZIMUTH
ELEVATION
RECEIVER AGC "A"
-100dbm -90 -110dbm -125 -135 -145dbm
AGC "B"
TAPE EVALUATION PCM PROCESSOR
SEARCH
LOCK
REAL TIME DATA
AVERAGED FRAME SYNC CORRELATOR OUTPUT
F.S. BIT ERRORS
3
2
1
0
DEGRADED AND LOST DATA LOW ELEVATION
BIT SYNC SLIPPAGE
SNTAGO
OSO-5
TAPE RECORDER W&W/FLUTTER DRIFT
+2%
+1%
(10KC, Mod. Index =5)
-1%
-2%
TAPE Nº 14
69/01/26
PCM SIGNAL PLUS NOISE
024400z
024500z
024600z
024700z
024800z
024900z

OUT FRAME /

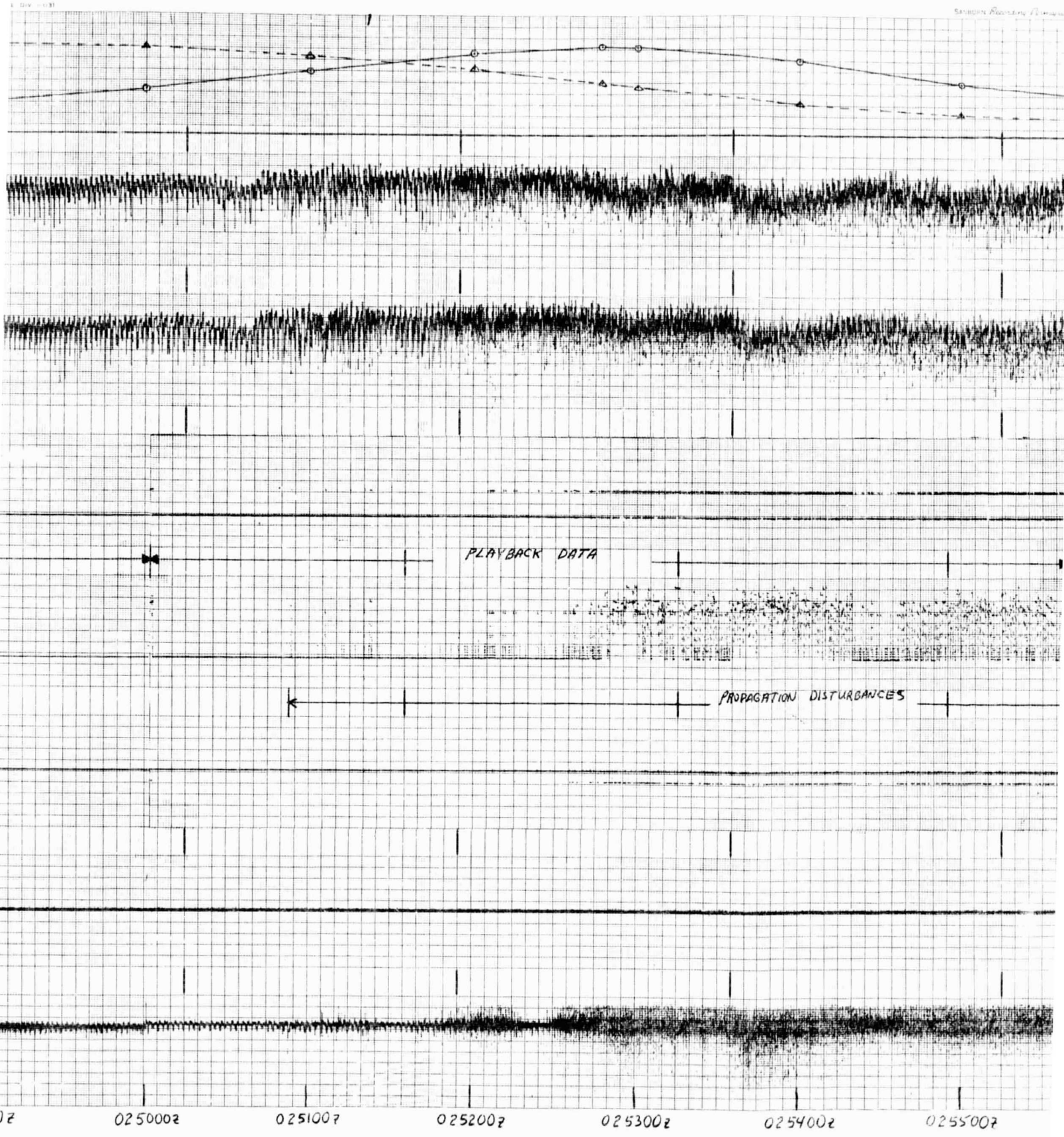
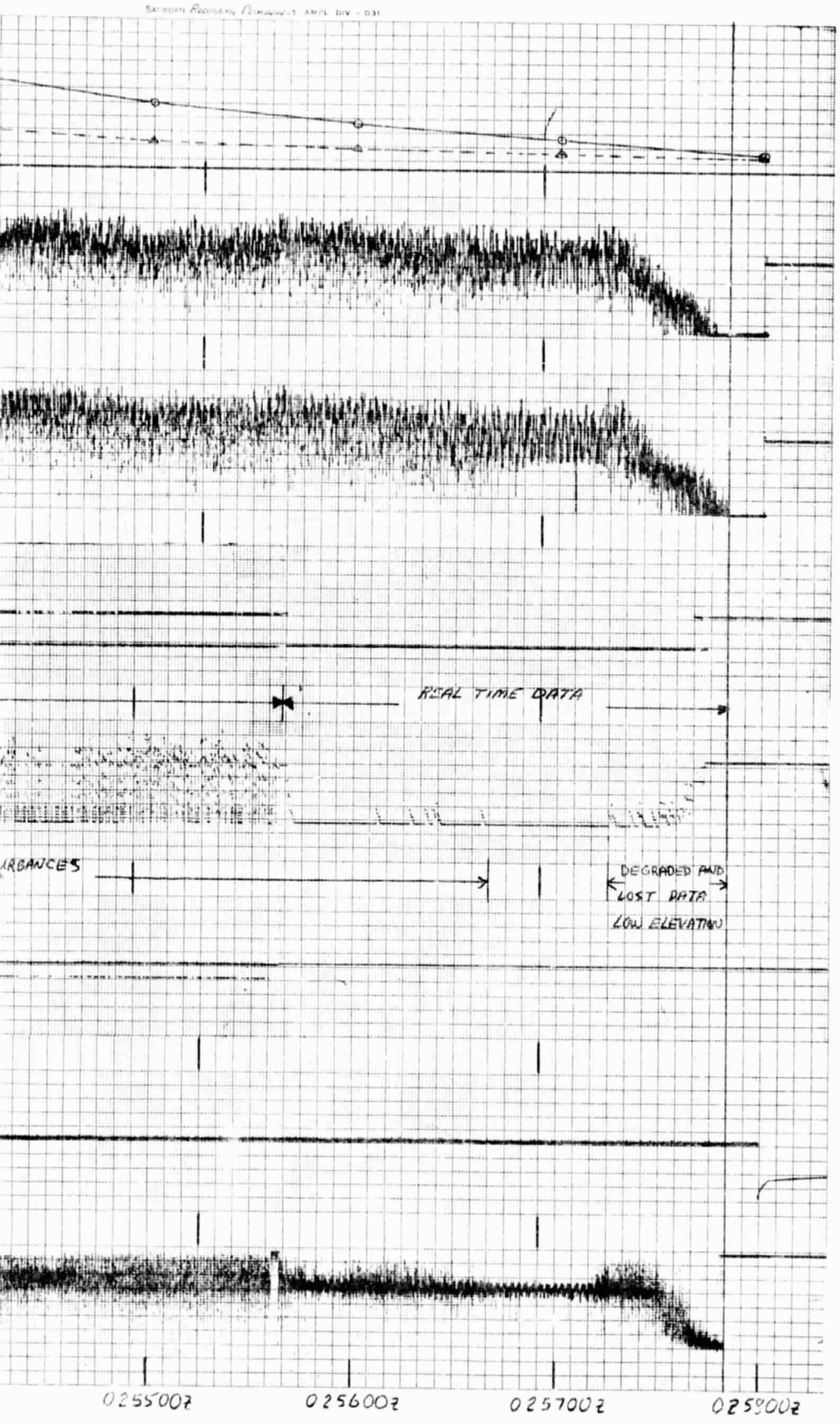


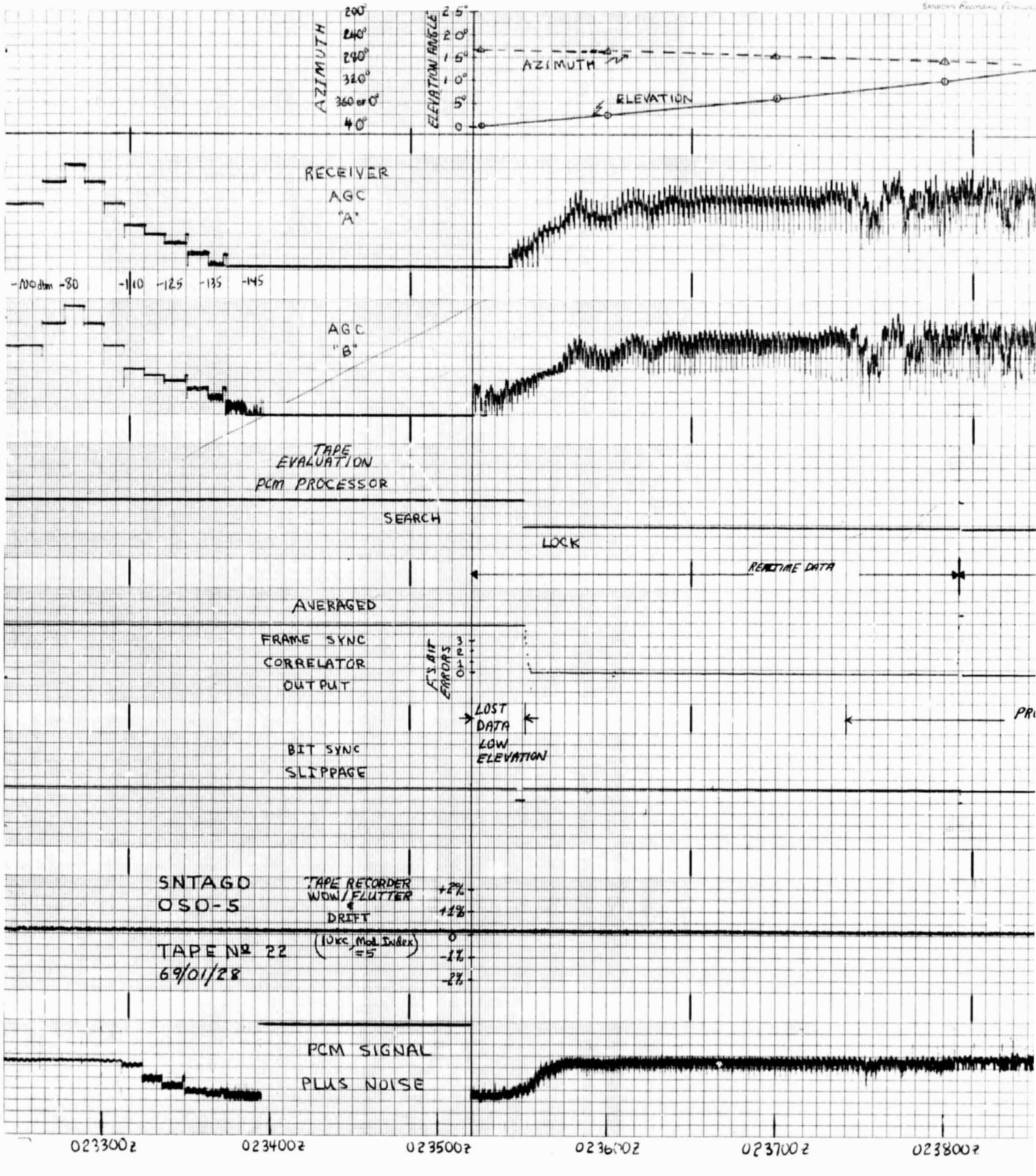
Figure B-6—IPD's Strip Char

FOLDOUT FRAME 2



ure B-6—IPD's Strip Chart Analysis of OSO-F Data; SNTAGO, Tape No. 14

FOLDOUT FRAME 3



FOLDOUT FRAME 1

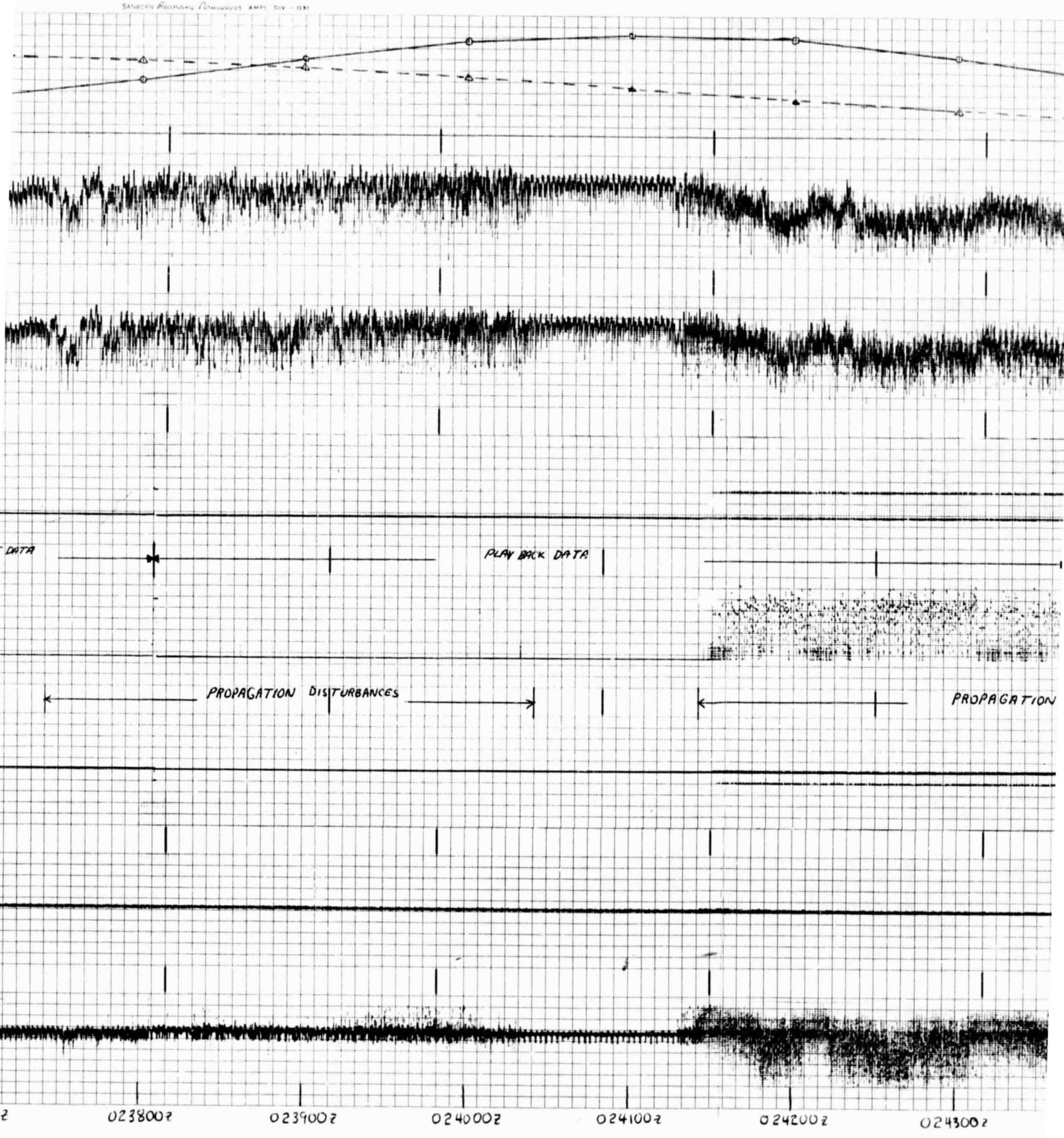
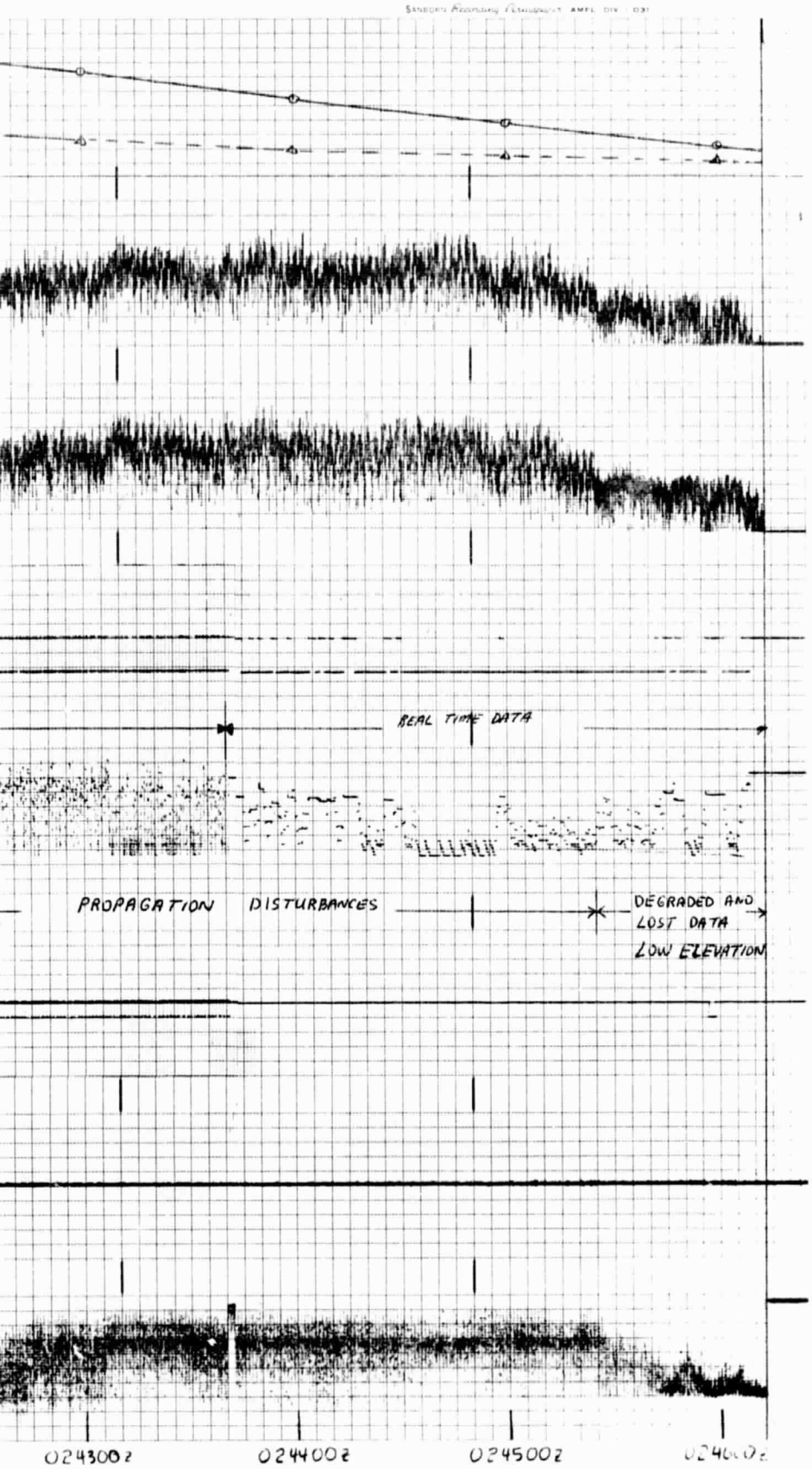


Figure B-7—IPD's Strip Ch

FOLDOUT FRAME 2

FOLD



B-7—IPD's Strip Chart Analysis of OSO-F Data; SNTAGO, Tape No. 22

FOLDOUT FRAME 3